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EDITORIAL NOTES.

Central Industrial Representation.

LAST year closed with the topic of the federation of the three principal organizations of the gas industry on the lips, and under the consideration, of members of these bodies; and the New Year has not made much of its history before the matter is again actively revived. It will be remembered that the three bodies—the Institution of Gas Engineers, the Society of British Gas Industries, and the British Commercial Gas Association—each deputed seven of its number to hold a joint meeting to discuss the question and report upon it. It is too much to expect official information as to what further movement has been made until there has been consideration by the three organizations. But, generally, it is understood that a meeting of the representatives of the Institution was held on Monday last week, when an outline scheme was prepared; and this formed the starting-point for the consideration and discussion at a meeting of the Joint Committee of representatives on Tuesday, when a scheme was evolved which will be submitted to the respective organizations.

We are aware there have been a good many mistaken notions afloat as to what is actually intended by this movement, and that judgment has been passed by many without knowing precisely what it is they have passed judgment upon. The greatest objection that there appears to be to federation—and we are quite in sympathy with it—is that not a few members of the three organizations are afraid that any merging through a scheme of this kind would mean the loss of identity and independence, and free exercise of the functions and powers at present possessed. The exact nature of the proposed scheme is, of course, a matter of privacy at present; but we believe that, when its precise lines are available, it will be found that all these fears are absolutely groundless—in short, that there is really nothing whatever in the scheme in the nature of amalgamation or federation that will at all affect identity, independence, or liberty. In effect, unless our information is at fault, what is proposed will simply be an invitation to each of the three bodies to appoint members to form a Central Committee for the gas industry, whose work will be to watch and ward the interests of the whole industry, and to unitedly advise the three organizations as to what should be done in regard to any matter of moment. While such a body would have permanent existence, it would not be paramount; the three organizations would be dominant, and only their separate decisions when in harmony would be determinate.

It is something of this kind, we believe, that will be submitted for discussion and consideration by the three bodies; and, as will have been seen, it is just about as far as it could well be from any process of absorption or annihilation of independent power. But the gas industry does badly want a representative body for conference and for watching and advising on many matters that are not covered by the Gas Companies' Protection Association. It wants a body representative of the technical, manufacturing, commercial, and financial interests of the whole industry. If it is such a Committee that is in contemplation, then we are certain that no member of any of the organizations will be able to see anything but good in the proposition.

New Lighting Competition—The Half-Watt Lamp.

THE new half-watt high-power wire-drawn electric lamp is now on the market; and, according to information obtained by a canvass instituted by "Electrical Engineering," the central station managers throughout the country are giving a hearty welcome to the lamp (though not at all anxious to see the half-watt low-power lamp), and are proposing to at once press the new-comer on to public notice. We hope that gas undertakings throughout the country have been, and are, paying special attention to the fields in which the new lamp will offer the strongest competition—street lighting, outside shop lighting, and large interiors—because, almost with one accord, the electrical engineers whose views have been elicited say that the cordiality of their reception to the lamp is due to the fact that it will give to them better means of competing with high-pressure and other high-power gas-lamps, and, at the same time, afford relief from the worry and bother occasioned by having to use the labour and the carbon absorbing flame arc lamps, in order to carry on anything like an effective rivalry with high-pressure lamps. The compliment to these gas-lamps is palpable; and gas managers who have not done anything in the fields of high-power units to fortify themselves against the higher efficiency electric metallic lamps had better bestir themselves at once, and no longer play the part of "foolish virgins."

The high-pressure gas-lamp has already done extremely good work in its competition with the flame-arc lamp; and this is not because the flame-arc lamp has not a high light efficiency in relation to energy consumption, but because, in the first place, the expense of the latter lamp has been great (leading to the acceptance of unprofitable prices) on account of labour and carbon charges, because in the second place the glare, colour, and unsteadiness of the lamps have diminished their favour, and because in the third place the liability of the lights to collapse has led to uncomfortable experiences at most unpropitious times. The electrical engineer will therefore have good reason for looking with a more favourable eye on the new lamp than upon the flame arc lamp as a competitor of high-pressure gas-lamps, inasmuch as labour charges will be reduced and carbon cost will be extinguished, and *per contra*, more of the money spent will be turned into the coffers of the central station, seeing that the candle-per-half-watt lamp will displace flame-arc lamps giving an efficiency of 3 or 4 candles per watt. Then the new lamp gives a white light; and there is not the same flickering as with flame-arc lamps. In common, however, with its precursors and contemporaries, it will suffer the ignominy of not being dependable, on account of troubles external to itself, and of having eye-injuring intrinsic brilliancy eight times greater than the old 1·3-watt-per-candle metallic filament lamp.

This extraordinary intrinsic brilliancy must prevent the new lamp being used in its naked form; and, therefore, it will be absurd making, for competitive purposes, calculations on the half-watt-per-candle basis. There is no dispute about the high intrinsic brilliancy. The additional intensity could not be obtained without considerably augmenting the temperature of the filament—increasing it, in fact, approximately 500° Fahr. above that of the ordinary metallic filament. Most of the half-dozen already well-known makers of these half-watt lamps freely admit that the intrinsic brilliancy is eight times greater than that of the old metallic filament lamp. This feature is one that can, with their authority, be pressed home as an inherent disadvantage of the lamp. The Osram people, however, seem to regard as quite a happy and commendable attribute of the lamp a condition against which scientific authorities—illuminating engineers, oculists, and others—have raised protesting voices. The Osram people say: "The intrinsic brilliancy of this new type is eight times "greater than that of the ordinary tungsten lamp. This "is all the more striking when it is borne in mind that the "latter has itself a brilliancy of approximately two-and-a-"half times that of lamps with carbon filaments." The British Thomson-Houston Company, on the other hand, wisely issue a warning against using the new lamps (they are the makers of the "Mazda" type) without eye protection. "It is," they say, "of *vital importance* that the vision should "be protected from the intense rays;" and they recommend enveloping the lamps in diffusing spheres or bowls. This will mean that the efficiency of a candle per half-watt will not be obtained.

But it is necessary for us as competitors to face the

question of the new position fairly and squarely. Although it will be absolutely essential to protect the eyes from the glare of these lamps, it must not be forgotten that, used with the indirect or semi-indirect systems, they will be more economical than the old metallic filament lamps employed, on either of these systems, in clusters so as to obtain a high-power unit. For street lighting, however, the additional height at which the lamps must be placed, in order to protect the eyes of drivers and pedestrians, will affect the question of economy in relation to illumination afforded at (say) 3 feet from the ground-level. It is rather interesting to notice that, while the candle powers attributed to the various sizes of new lamps exactly represent the result of multiplying the watts used per hour by two, the word "approximate" is used. This is a necessary safeguard, as all the lamps that have been tested do not show either a horizontal or a mean lower hemispherical reading that allows an efficiency of 1 candle per half watt to be ascribed to them. It is also stated that the lives of the lamps will be the equivalent of 800 to 1000 hours' use; but, at the increased temperature, it will be interesting to see what the effect will be in increasing the fragility of the filaments, owing to their change to a crystalline character. We assume that, notwithstanding that the bulb of the lamp is filled with nitrogen, the change in the filament will take place at the same pace as, or at a more rapid pace than—the temperature being higher—a filament at a somewhat lower temperature in vacuum, as in the case of the ordinary metallic filament lamp. The object of the inert gas appears to be solely to prevent the increased loss of candle power that there would otherwise be owing to the higher temperature causing some additional discoloration of the bulbs by tungsten nitride. With the bulb charged with nitrogen, the emanations produced by the action of the temperature on the filament are said to be carried vertically upwards by convection currents, and distributed on the elongated neck with which the bulb is provided. How far this is effective, time will soon reveal. We have pointed out these various matters, so as to show where the new lamp may possess advantages, and where the disadvantages may be looked for.

The most careful investigations in the laboratory do not show that it is possible to apply the new principles of metallic filament lamp construction to low-power units, owing to the great heat loss by convection (in a nitrogen-filled lamp) from the fine filaments of the small units. Thus it comes about that the lowest unit of the half-watt type is nominally of 600-candle power (300 watts); and the sizes above are nominally of 1000, 2000, and 3000 candle power. Only 2000 and 3000 candle power lamps have as yet been obtained to run on 200-260 volts; 1000, 2000, and 3000 candle power sizes are made to run on voltages from 100-130; and 600 and 1000 candle power units, for voltages of 50-65. We should like to know whether the claim of half watt per candle really applies to all these units at the voltages named. However, it is seen that, at any rate, the 600 and 1000 candle power units must be run in series, which will be a disadvantage for small shop lighting unless on the parade system. The advertised prices of the lamps are 30s. for the 600-candle power unit, 35s. for the 1000-candle power unit, 50s. for the 2000-candle power unit, and 60s. for the 3000-candle power unit. For street lighting, these prices mean a tremendous expense. The reputed life, as given by the makers, presumably for lamps running under laboratory conditions, is 800 to 1000 hours. Therefore, taking a public lighting contract of about 4000 hours per annum, this would mean the use of at least four lamps a year, or £6 for the 600-candle power size, £7 for the 1000-candle power size, £10 for the 2000-candle power size, and £12 for the 3000-candle power size. The advertised prices are no doubt subject to discounts; but anyway the figures disclose, even assuming the life figures to be correct, a very heavy renewal account (to say nothing of premature breakdowns), which present-day competition will not stand. Owing, too, to the high temperature of the bulbs, due not only to radiation but to convection, the lamps must be enclosed in specially constructed draught-proof lamps for outdoor use, or there will be disaster to the bulbs.

From the figures given, assuming there is no depreciation of the efficiency during the life of the lamps, and that they have a life of 1000 hours, it is easy to calculate what would be the expense for the two items—current and lamps. Take a 300-watt lamp (600-candle power), in 1000 hours it would consume 300 units. Assuming only 2d. per unit was charged for these for shop lighting, this would represent £2 10s. for current in the 1000 hours; and the lamp costs £1 10s. The two items, making £4, are equal to 0·96d. per hour. In 1000 hours a 2000-candle power lamp would consume 1000 units, which, at 2d. per unit, would be equal to £8 6s. 8d.; and the lamp costs £2 10s. The two items make £10 16s. 8d., which works out to 2·6d. per hour for the reputed 2000-candle power lamp. If only 1d. per unit was charged, the cost per hour would come down to 1·6d. for the 2000-candle power lamp, for current and lamp, assuming 1000 hours' life.

This is the new lamp that is challenging the gas industry in street, shop, and large interior lighting; and it is limited to these fields, seeing that the householder can no more adopt it for his purposes than he can the flame arc. With the high-pressure gas system, there ought to be no difficulty in combating the new lamp, against which it is, as the Thomson-Houston Company state, of "vital importance" that the vision of communities should be protected.

Woodall-Duckham Verticals at Birmingham.

It is a far cry to 1886; but in that year it was our pleasure to publish a series of illustrated articles describing the extensions being carried out by Mr. Charles Hunt, the then Engineer, at the Windsor Street works of the Birmingham Corporation Gas Department. The extensions were on the most advanced lines of contemporaneous gas engineering; and there was economy in the work, and economy in the results. The Windsor Street station, under its present Engineer, Mr. John Foster, does not hang behind in the race for higher efficiencies, as is shown by a paper read by Mr. Charles F. Tooby before the Midland Junior Association last Saturday. The paper is descriptive of the 5 million per diem Woodall-Duckham plant, which production is realizable with 22 beds of four retorts; and it also includes an account of the experiences of operating methods as adopted at Windsor Street. All this is interesting and useful; but it does not give much scope for discussion, other than by way of the narration of comparative experiences and modes of working in other circumstances.

The author, however, throws open the door to controversy by an innocent looking question towards the end of the paper. It is this: With the higher external temperatures near the top of the retort, is all the coal subjected to as thorough a distillation as it might be? We should have liked to have had Mr. Tooby's own answer to that question. But judging from the data given as to working results with a medium-class coal, and looking at the analysis of the gas, there does not appear to be anything much of which to complain that is attributable to the system of heating. If there were indications of any particular coal not being properly carbonized, then we might well say that the regulating of the extractor to a somewhat slower speed would effect the remedy, though to the extent of the reduction of speed the carbonizing capacity would be lowered. It is one of the advantages of such retorts, that the carbonizing period can be adjusted to a nicety, and promptly, to the character of the coal. While a comparison of results does not reveal any particular advantage between the highest heat of a vertical retort being situated at the top or at the bottom, it certainly appears to be a rational and natural order of operation to subject the cold coal in the retorts to the highest temperature; for it is at this stage that the charge is most absorbent of the external heat, and there is most work to be done. Then the outside heat should be reduced as the coal descends; there being less need for the application of outer high temperatures to the incandescent charge, which in itself is contributing to the carbonizing work in the retort, supplemented by the heat energy proceeding from the sides of the retort. The arrangement also contributes to the heat efficiency of the settings, and to a reduction of the waste of heat by way of the coke.

Occasional trouble is to be found with the clinging of the charge at the top; and it is an interesting point that is made as to the core of the charge being often thrown out of the centre. This is rather strange; and if it is not a permanent experience, it seems that there must be something of local or temporary occurrence to account for it. There is also a little trouble with pitch. Mr. Tooby criticizes the heat provision for the free space, as well as the present arrangement of a division-plate between it and the charge, which plate, he considers, has a detrimental effect on the mechanical working of the charge and on the quality of the gas. These criticisms will, without doubt, receive attention in the proper quarter. There is agreement with the suggestion of the

author that there are various matters about the working of the plant that it would be instructive to investigate; but we ask where this could possibly be done better than at Windsor Street.

Sulphate Position and Prospects.

We do not envy Messrs. Bradbury and Hirsch the task they had in preparing their newly-issued annual report on the sulphate of ammonia market. It was true they were not twelve months ago particularly hopeful as to the market in 1913, although, at the time they were looking ahead, they were surrounded by uncertainties. In the event, the past year has been one of surprises; and it has not been an easy task—this is obvious from the report before us—to gather together the threads of the varying situations of the year so as to explain the break in market prices, and to form some sort of anticipation as to the future, regarding which, in its immediate aspect, there is not much promise of improvement. At the same time, sulphate of ammonia stands strongly among the fertilizers; and it has now come to be realized that it is in truth the controlling one. This is seen by the interesting dissertation prefacing the more prosaic, and in places somewhat sombre, parts of the report, and which treats of the relations of sulphate of ammonia, nitrate of soda, and atmospheric nitrogen, the last of which has now to be taken seriously into account, as it is with us, and will with extensions of plant increase in the future, having, so one report tells, a good margin between cost and market value for lower prices, if necessary. But there is a price (which another report says is found to be higher than has been represented) below which the producers of atmospheric nitrogen cannot work; and there is a level of price below which the producers would gain no financial advantage by working in a manner that would further depress the selling value. The nitrate of soda producers are in much the same boat; and they cannot afford to let their supplies so far outstrip demand that the price crumbles away. This has been seen during the year; and, in their own protection, they have had to agree to restrict output. Had they not done this, with the increased stocks available to-day, and with the position of competitors, their state this current year would indeed have been a parlous one. As it is, the outlook is not particularly bright. The output of sulphate of ammonia stands in a different category, as no control, save bad working, can be exercised over production. This fact does not make it any the easier for the nitrate of soda people to voluntarily restrict their output, although it is one of the elements in the force of circumstances that brooks of no neglect. It is to the interest of the sulphate of ammonia producers to see the price of nitrate of soda maintained, just as it is of the nitrate of soda people to see the price of sulphate of ammonia kept well up; and the atmospheric nitrogen people will always do better while both the competing fertilizers are at good prices. Not one of the three producers can really afford to see the market values of their competitors' wares materially decline. It was the relative cheapness of sulphate of ammonia during the year, as well as over-production of fertilizers, that compelled the nitrate of soda producers to restrict their output in order to keep prices from further shrinking.

A year ago Messrs. Bradbury and Hirsch did not by any means try to buoy-up hopes that the average price of sulphate of ammonia for 1913 would be anything like that of 1912; and the event proved their sagacity in reading such signs as there were available to them. As a matter of fact, the average price last year was £13 7s. 6½d., or £1 0s. 2½d. less than in 1912. But unfortunately in December the average price was upwards of 11s. lower than the average for the year. The result is very disappointing; but there was nothing realizable during the year that could have bettered the result under the circumstances. Supplies of fertilizers in the course of the twelvemonth became far more abundant than the demand. Germany (although importing some) did not absorb the whole of its own sulphate of ammonia production; and German producers in November had to reduce their price. The nitrate of soda market also collapsed. Had it not, in fact, been for an increase in our exports of sulphate of ammonia, by 37,840 tons, to 324,704 tons, which increase more than absorbed the estimated additional production of the United Kingdom (32,000 tons), the result of the year's marketing of the sulphate would have been worse than it was. We cannot help feeling that the increase in exports which saved things falling away to a worse degree is a justification for the share that is being taken by the Sulphate of Ammonia Committee in stimulating in distant parts abroad the use of the fertilizing product of coal carbonization. The greatest surprise of the year was the increase in demand by 28,000 tons from Japan, and even the Continent made an unexpected development in its purchases. But the volume of trading with the United States was the lowest experienced for four years. However, there is one good thing that, through the compensations provided by the variety of requirement in a variety of geographical locations, the market is saved from violent flights to extremes in prices.

We have to keep fixed in mind the continual increase in production, so as not in any way to allow the relaxation of efforts in the attempt to cause demand to stride forward with equal pace to supply, though the other fertilizers will always be tugging away at sulphate of ammonia in the endeavour to improve their own position. The estimate made by the present reporters of the increase in the world's production of sulphate of ammonia last year is 139,000 tons; the total being 1,439,000 tons. To the increase, Germany (with a production of 550,000 tons) contributed 65,000 tons; the United Kingdom (with a production of 420,000 tons), 32,000 tons; France, 6000 tons; Belgium, 2000 tons; the United States (with a production of 193,000 tons), 28,000 tons; and the balance was made up by Austria-Hungary and the rest of the producing countries. Regarding the increased production in the United Kingdom, if coke-oven, carbonizing, and producer-gas plants continue to double the increase that gas-works can show, their total production will soon overtake that of the gas industry. According to the estimates (which we are not on this occasion prepared to criticize as we were those made for 1912), the production from gas-works last year rose by 10,000 tons to 182,000 tons; while the production of the coke-ovens and the other carbonizing plants rose by 20,000 tons to 157,000 tons. We rather fancy that, unless the price of oil again comes to the aid of the gas industry, there will be no abatement at present in the greater use of coal for gas production, unless the coke market forces a change from present manufacturing procedure. But, on the other hand, there are indications of a possibility of some recession this year in the demand for metallurgical coke. If this is so, the present lead of the gas industry in sulphate production will not be very much affected during the current year.

What of the current year? Messrs. Bradbury and Hirsch do not incite hope that there will be substantial improvement in sulphate prices, which are (it is hoped only temporarily) discouraging at the opening. When the promising and antagonistic aspects of the visible situation are examined in juxtaposition, they are found to about balance one another, and to suggest the maintenance of the recent conditions. It is hoped that there will be a larger consumption of fertilizers all round, owing mainly to the extension of requirements for foodstuffs, and the greater spending powers of the people. It is likely that the cotton fields will need a good supply (America is already largely committed to sulphate of ammonia this year); and it is also thought probable that an increased demand will be made for sugar growing. But there is the increasing production of sulphate of ammonia, which is an uncertain quantity; and year by year atmospherical nitrogen threatens to increase in importance. There are greater stocks of sulphate of ammonia and nitrate of soda available now than at this time last year. The restriction as to the production of nitrate of soda will be removed at the end of this month, unless there is a renewal of the agreement. Thus the chances of doing better this year appear to be somewhat remote.

Results of Gas-Engine Inspection.

Many users of gas-engines appear to regard them as being different from most other moving things, in not requiring occasional examination, adjustment, and overhauling; and they run the engines so long as they will run without any consideration as to efficiency. It is to the interest of gas undertakings not to allow this sort of thing to continue in these days of keen competition for the power load. The only way to meet heedlessness of the user is by taking in hand the matter of technical inspection and adjustment, and where repairs are necessary to make recommendations accordingly to the owner. In 1912, Mr. R. Wardell read a paper on the subject before the Eastern Counties Association; and he showed how, by very simple adjustments, users of

engines had obtained a higher efficiency, and the gas undertaking concerned had had more contented power users. The Gaslight and Coke Company and the South Metropolitan Gas Company have shown a large enterprise in the same matter, as was divulged by Mr. W. A. Tookey—an expert in internal combustion engines—in a paper he read before the Institution of Mechanical Engineers last Friday. Acting under the instructions of the Companies, he has made a systematic and thorough investigation of the working of, up to last autumn, nearly 800 engines, and has reported upon them—showing the improvements effected in working by simple adjustments, and the improvement the engines were capable of by the repair or renewal of parts. The figures are worth consideration. He found it possible to effect improvement in 66 per cent. of the engines merely by the adjustment of the gas or air supply. The average improvement in regard to the increase of power per impulse was 27 per cent. For example, an engine found to be giving a mean pressure of (say) 60 lbs. per square inch would be left giving 76 lbs. with the same or even a decreased gas consumption under the same load and speed. The average reduction in gas consumption was 13·3 per cent. on the indicated horse-power-hour basis. These are remarkable figures, and should be highly persuasive among those having the management of other gas undertakings. High efficiency and certainty in engine working constitute a defence to the power load.

Defeat of the Extremists.

The labour extremists have had a bad time during the past week; for they have been shown that the new methods by which they seek to open wider the hands of employers are not palatable either to communities or to strong governments, and that, while there are other means of settling differences and grievances, the general strike and the interruption of the daily course of affairs at the command of the labour demagogue are not going to be tolerated. The whole world has had its eye on South Africa; and the South African Government has set an example to the rest of the civilized world, and shown it how to deal with the general strike. The speed with which the strikers returned to work throughout the Cape when their leaders were arrested, shows how unsubstantial were the grounds for all their assumed grievances. The whole affair was a remarkable object-lesson in the method of dealing with an ugly situation, and in the activity of a well-paid labour in coming-out and in going-in. There is often more artificiality than reality about these grievances of labour. Much the same thing has been witnessed at Leeds, where the firmness of the Corporation has caused the general municipal strike to be nothing more than a fiasco. The men, or as many as could be taken on, have returned to work on terms that were open to them before Christmas, and their leaders have made an inglorious retreat from the city. Leeds has suffered a little inconvenience in connection with the municipal service. But the city has rendered excellent service and example to other municipalities; and (there is good ground for thinking) a salutary lesson has been administered to those who intrude and stir up strife between master and servant when already fair conditions exist. There again at Leeds there was (as in South Africa) a conspiracy against the community; and the community was not prepared to yield to coercion.

National Assets.

It is well to be reminded sometimes of the enormous importance as a national asset of the mineral deposits of this country; and a suitable opportunity for drawing attention to the matter presents itself in the appearance of the annual Home Office statistics relating to the output of various mines and quarries. The report for the year (1912 some figures from which were reproduced in last week's issue) shows that during the forty years beginning with 1873 minerals have been raised to the total value of £3,359,004,435. Coal, of course, accounts for by far the greater part of this sum—in fact, for £2,805,058,716, or 83·5 per cent. Of the 7,653,148,000 tons of coal which have been raised in the period named, 1,833,463,000 tons have been shipped abroad as exports, in the form of coal, coke, and manufactured fuel, and as coal used for steamers engaged in foreign trade. Over the whole amount, this represents a proportion of nearly 24 per cent.; but in each quinquennial period during the forty years the exports have represented a rising proportion of the whole output. The percentage for the year 1912 had risen to over 32. There was a special circumstance, in the shape of the national strike, which affected the output of coal in that year, and so the figures are, in a way, hardly comparable with those for the preceding twelve months. Actually, there was a decrease on the output during 1912 of about 11½ million tons on that for the previous year; but at the same time the value of the coal produced was more than £7,000,000 greater. Both these results are attributed in the report to the strike, which thus hit consumers badly. The value of the 260,416,338 tons of coal raised was £117,921,123; and the average price per ton was 9s. 0·68d., as compared with 8s. 1·79d. in 1911. The total quantity of coal which left the country in one form or another was nearly 86 million tons; and there was therefore left for home consumption 174½ million tons or 3·823 tons per head of the population, as against 4·079 tons for the preceding year. The total quantity of coal used for the manufacture of coke (including gas-works) was 33½ million tons; and another big consumer is represented by the blast furnaces for the manufacture of pig iron, which accounted for 18 million tons. The 7,629,716 tons of coke obtained at gas-works in the United Kingdom compares with 7,483,105 tons in 1911.

PERSONAL.

On the recommendation of the Lord Lieutenant of Warwickshire (Lord Craven), a number of names have been added by the Lord Chancellor to the Commission of the Peace for the County of Warwick; and among them we notice that of Mr. THOMAS BERRIDGE, of Leamington.

The position of Chemist to the Harrow and Stanmore Gas Company has been filled by the appointment of Mr. T. V. JOHNS. The successful candidate, who leaves the Wellington (Salop) Gas Company to take his new position at Harrow, is the younger brother of Mr. W. H. Johns, the Gas and Electrical Engineer to the Malvern Urban District Council, and President of the Midland Junior Gas Association.

Mr. ALFRED B. TOBEY, the Manager of the City of Durham Gas Company, has been appointed Engineer and Manager of the Townsville (North Queensland) Gas-Works in succession to Mr. W. Aird. Mr. Tobey, who was formerly Assistant Manager at the Scarborough Gas-Works, has been at Durham nearly twelve years, having in May, 1902, succeeded Mr. E. H. Millard. He is the son of Mr. Henry Tobey, of Malton, and is a brother of Mr. B. Seymour Tobey, of Horley.

Mr. ROBERT SHEPHERD celebrated last week his jubilee in the service of the Glasgow Corporation Gas Department, and was presented with a purse of sovereigns and a valuable walking-stick, suitably inscribed. Bailie Irwin, the Convener of the Gas Committee, who presided at the ceremony, said Mr. Shepherd in 1863 joined the City and Suburban Gas Company, which was taken over some years later by the Glasgow Corporation. Fifty years ago the staff of gas-fitters under Mr. Shepherd was about a dozen, and the average wage was 18s. weekly, with a 60-hours working week. He now controls about 300 men; the average wage being 38s. with a 51-hours week.

Mr. JOHN RICHARD HEATH, the Engineer and Manager of the Staffordshire Potteries Station of the British Gaslight Company, Limited, will retire on the 31st of March. Mr. Heath, who is 53 years of age, has been for thirty-five years in the Company's service at the Potteries—sixteen years as Engineer and, previously, for fourteen years as Assistant Engineer, two years under the late Mr. Robert Linging and twelve years under Mr. John Young, the present Engineer of the Company's station at Hull. Mr. Heath underwent a serious operation in 1902; and, although this was successful, his health during the past few years has been very indifferent. Two years ago he was dangerously ill—an acute attack of bronchial asthma confining him to the house for two or three months. Although his health has now happily improved, Mr. Heath has decided—with the view of maintaining the improvement—to relinquish his duties; and the Board have granted him a generous retiring allowance. The new works of the Company at Etruria were erected under Mr. Heath's superintendence.

OBITUARY.

The death occurred, on the 9th inst., of Mr. GEORGE GRAHAM, the Gas Manager of Leslie, after only twenty-four hours' illness. For thirteen years Mr. Graham had been connected with the Company, and had improved and extended the works. He was said to be "most strenuous in promoting the welfare and convenience of the community, and was an exemplary public servant."

The death occurred last Wednesday, in his eighty-first year, of Mr. PEMBROKE SCOTT STEPHENS, K.C. He was called to the Bar fifty-one years ago, and soon afterwards began to report, in association with the late Mr. F. Clifford, K.C., the cases which came before the Referees on *locus standi*. He took silk in 1882, and two years later was made a Bencher of Lincoln's Inn, of which he was elected Treasurer in 1910. He was held in very

high esteem by his colleagues at the Parliamentary Bar—succeeding the late Sir Ralph Littler as its titular head. His appearances in the Committee rooms were very frequent, for the purpose of representing promoters and opponents of Gas and Water Bills; and in this way his name was at one time familiar to "JOURNAL" readers.

Keen sympathy will be felt with Mr. B. W. Smith, of Walsall, by those of his friends who have not so far heard of the sad event, in the loss he has sustained through the death of his third son, Mr. NORMAN FRASER SMITH. The sympathy of those colleagues to whom his sorrow has become known has already been manifested in a manner which Mr. Smith deeply appreciates. Mr. Norman Smith, who was 32 years of age, died on the 17th ult., in the Maryborough Hospital, Queensland; and a cable to this effect reached his father the following day—one short week after he had had a most cheering letter from his son saying how well he felt. The letter was dated December 8, or only nine days before he died. By a later mail, however, a note has come from one of his friends saying how ill he was after an operation for appendicitis. For over twelve months Mr. Norman Smith had been acting as Engineer and Manager to the Maryborough Gas Company, during which time several important structural alterations and additions were carried out. Previously he was for eight years with his father at the Walsall Gas-Works.

BEIT FELLOWSHIPS FOR SCIENTIFIC RESEARCH.

WE have been asked by the Secretary of the Imperial College of Science and Technology, South Kensington (Mr. A. Gow, B.Sc.), to notify that the second election under the fellowships for scientific research founded and endowed by Mr. Otto Beit, in September last, "to promote the advancement of science by means of research," will take place on or about the 15th of July next. The fellowships are of the annual value of £150, and are tenable at the College for one year, or for a further similar period at the discretion of the Trustees. Not more than three fellowships will be awarded.

Every Fellow must be a man or woman of European descent by both parents, but otherwise of any nationality whatever, who at the date of election is under twenty-five years old, has taken a degree in any faculty in a University in the British Empire approved by the Trustees, has passed the examination which would have entitled him or her to take such degree, or is in possession of any diploma or associateship of any college approved by the Trustees. Candidates are to make application in writing, give full information as to their qualifications, academic standing, and previous career, and state the general character of the research they propose to carry on. In considering merits, regard will be had to their personal record, the importance of the research work suggested by them, and that upon which other Fellows are engaged or which other candidates propose to carry on. The Trustees will specify the research work a Fellow is authorized to undertake. Fellows will be attached to a department of the Imperial College, and will work under the supervision of a professor. Every Fellow will have to furnish on the 15th of June a detailed written statement of his work from the date of his election up to that day.

Applications must be received on or before April 15; and forms and all information may be obtained by letter addressed to the Rector, Imperial College, South Kensington, S.W.

Gaslight and Coke Company's Dividend.

The Secretary of the Gaslight and Coke Company (Mr. Henry Rayner) informs us that the accounts for the past half-year show that (subject to audit) the balance to the credit of the net revenue account will enable the Directors to recommend the payment of a dividend at the rate of £4 17s. 4d. per cent. per annum; carrying forward to the next account the sum of £614,052 16s. 5d. This time last year the dividend was at the same rate, and the amount carried forward was £712,387 4s. 10d.

Bridge of Allan Gas Arbitration.

The award was made known yesterday in the arbitration to determine the price to be paid by the Bridge of Allan Town Council for the undertaking of the local Gas Company, which took place recently in Edinburgh (and a full report of the proceedings at which will be found in the "JOURNALS" for Dec. 30, Jan. 6, and to-day's issue). The Oversman (Sheriff John Wilson, K.C.) has put the figure at £29,953; but if there is no legal right on the part of the Company to a supply of water referred to in the case, the amount is to be £29,453. The award includes accounts, due stocks, cash in bank, and investments, all as shown in the balance-sheet dated Feb. 1, 1913, amounting to £2300, with 4½ per cent. interest. The Town Council are to pay the taxed costs. The lower alternative sum exceeds the offer made by the Town Council (£26,685) by less than £500.

Messrs. E. & F. N. Spon, Limited, announce the publication of the twenty-seventh edition of "Molesworth's Pocket-Book"—price 5s. net.

THE HYGIENIC ADVANTAGES OF GAS.

WE have had it on the authority of one who describes himself in a contemporary as a "M.O.H.," that electricity as a lighting agent attends strictly to business, and does not incidentally effect any sterilization of the air of the room in which it is employed. In ordinary circumstances, he has said, sterilization of the air is not necessary; but, if sterilization is necessary, cheap and easily worked disinfectors are readily obtainable. He has not said which of these disinfectors could be used in conjunction with electric lighting in a room during occupation. No doubt he would be prepared to advise users of electric light on this point, and perhaps he would seize the opportunity to mention to them that on the 19th ult. he informed his readers that "from the sterilization point of view the incandescent (gas) light is not nearly so good as a fishtail light or even a candle." But they must not ask him on what grounds he makes such a statement, and still less must they ask him for experimental demonstration of its truth; for he will only say that, if they do not place unquestioning belief in every statement he chooses to make, they display an unscientific spirit, are ill-informed, and know nothing whatever of the amenities of controversy.

This is, in effect, the only response which a "M.O.H." has been able to give to the readers of "The Sanitary Record and Municipal Engineering" to our request to him in the "JOURNAL" for Dec. 23 last (p. 930) for proof of his statement, which must have amazed everyone having technical knowledge of gas and candle flames. He will not—doubtless for a very good reason which will be apparent to everyone—give proof of its truth. It must be accepted merely because he says it is so. On this basis, one whose only claim to distinction or authority of which we are aware is that he is a "M.O.H." who is allowed to write a few columns in our contemporary expressing views which frequently do not tally with those of his Editor, should be accepted as sole arbiter on any technical matter, whether, let us say, a question relating to aviation, submarines, coal mining, or the manufacture and use of calcium carbide. Writers of repute on these matters must be challenged as to every statement which they have made after years of special study of their subjects, if the statement does not happen to coincide with the preconceived views of an anonymous "M.O.H." Since the latter has no proof of his own to offer as to the truth of his statement, can he find any reputable authority to back it with his signature? Surely it is not unreasonable to ask this of an anonymous writer who has no editorial support.

We may leave it to "M.O.H." to find proof or backing for his definite statement, and, by his response, his claim to speak authoritatively on any question regarding the hygienic aspects of different methods of lighting may be judged. We hope he will not, by failure to respond in a straightforward and convincing manner, leave his readers to infer that, by writing under the pseudonym of a "M.O.H.," he is, by his rash, biassed, and unsupportable statements, damaging the repute of the Medical Officers of Health throughout the country. It is a pseudonym which carries with it responsibilities to his colleagues as well as to the general public which we think the user of it has failed to realize.

Nothing has yet appeared in the discursive effusions of a "M.O.H." which disproves in any way the hygienic advantages of gas as an illuminant. He admits that he has a bias in favour of electricity; but he must have very poor confidence that it has real advantages, since he thinks it necessary to belittle its successful rival by statements embodying gross exaggerations, if not actual untruths. As a fact, he is so injudicious a writer that he damages the cause he espouses.

A PILE OF LITERATURE

From the British Commercial Gas Association.

THE British Commercial Gas Association appear to have adopted several mottoes, or perhaps it is better to say golden rules, one of which is "never put off till the morrow what one can do to-day.' Some pedantic friend may say this is not exactly the true rendering of the useful old adage; but it is near enough for our purpose. There is a substantial pile of literature on our desk that has been delivered from Mr. W. M. Mason, the Secretary to the Association, and to which pile we are asked to give some little consideration and notice. As we look through the components of the miniature stack, we are not a little amazed at the celerity with which the staff of the Association perform their work, and which makes us think they conscientiously endeavour to live up to the golden rules of active life, one of which we have quoted. The National Gas Exhibition only closed its doors on Nov. 1. As we look back upon that busy month, its days seem to have been packed with congresses, lectures, and meetings of various kinds—including the annual meeting of the Association itself. But although only a little more than two months have passed away, with work interrupted by the Christmas Holidays, here we have the reports of the whole of the congresses, lectures, and meetings all orderly arranged and bound up for reading and reference, and not only these things but the January "Bulletin" and some fresh literature for circularizing are also in the pile. There has been no waste of time here. The extraordinary work of last year has all

been tackled and kept by the Association's staff within the bounds of the 313 working days, with perhaps a little trespass on the others; so that they start on the new year without the encumbrance of arrears of work, and ready for all that initiative suggests and circumstance and casual events demand.

We pull from the bottom of the pile what looks like a heavy, bound volume, with, in gilt type, "National Gas Congress Papers, 1913," printed on the back. It is a deceptive thing this volume; for, examining it, it takes the form of a box, accommodating eight paper-bound volumes, containing the verbatim accounts of the whole of the lectures delivered at the National Exhibition, and the whole of the papers read at the congresses. The box so long as the contents are there may be looked upon as a perfect store of things one ought to know, bearing on all sorts of topics connected with applications of gas. We think the volumes may be had separately; for the volume of lectures is priced at 2s., and the volumes of papers at the congresses are marked 1s. each. There are some of these volumes that ought to be placed in the hands of every responsible official on the commercial side of a gas undertaking, and of every salesman employed by gas lighting and heating appliance manufacturers; for, unless they know the things that are in these volumes, their education is far from being complete, and their effective service must, in proportion to the incompleteness, be curtailed. In the "Bulletin" for January, we see that the irrepressible "F. W. G." starts his notes from the Committee Room with the words: "There is much of practical wisdom in the old proverb that tells us that 'the mill can grind no corn with the water that has passed.'" The proverb does not apply to the contents of the volumes before us; for though a perfect torrent of words is presented in them which all flowed from excellent sources during 1913, they will, for many a long year to come, supply good operating power for use by those who are responsible for commercial gas work throughout the United Kingdom.

The next volume we take out of the pile is the report of the second annual conference of the Association, and a goodly volume it is—commercially stimulating and suggestive. The other authors will forgive us saying that the volume is worth the 2s. asked for it alone for the informative and extensively illustrated paper by Mr. H. M. Thornton on the industrial uses of gas. This paper (we rather think we have said before) was an eye-opener. The volume has been edited by Mrs. Cloudesley Brereton, which is a sufficient assurance of freedom from literary blemishes. Like the books already mentioned, this one ought also to be well digested by every commercial gas manager and assistant before being placed in the individual repertory where useful things are preserved.

The "January" Bulletin comes to us in new dress; and we congratulate the Editor and Committee upon it. It looks, without the cover, a more business-like production for a business organization; and though the accounts show to our practised eye that the expense of the "Bulletin" in the past has been quite moderate, we can see that there is economy in divesting the production of its outer and not valuable wrapper. It was ornamental, but nothing more. The useful work of the Association is extending, as is seen by the interview which the Chairman of the Executive Committee (Mr. F. W. Goodenough) has had with the Government Departments supervising factories and schools regarding the use of flueless radiators in large buildings, and by the conferences, held, under the auspices of the Association, on the subject of coke. Further allusion to these matters (out of which good is coming) is found in our "Miscellaneous News" columns. The branching-out in service is also noticed in the note by "F. W. G." to which reference has already been made. He writes:

> The signs certainly are favourable for a good showing of fresh enterprise and activity in the near future. Plans for assisting members in stimulating the sales of coke in their districts are steadily maturing; arrangements for the holding of local conferences in all the districts are now being made (much is hoped from this stirring-up of local interest and enthusiasm); and research work is being planned which it is believed will be of value to the industry as a whole.

The new literature for circulating among consumers consists of three items which we can strongly recommend. The first one is a pamphlet, comprising a mass of information for gas consumers written in the form of letters. The illustrated title-piece on the first page contains the words: "Letters of a Grandmother;" but it is a little unfortunate that close under those words appears: "Mrs. Cloudesley Brereton, M.R.San.Inst., M.I. Hygiene, &c.,"—"unfortunate," because we do not believe there should be any inference from the association other than that of authorship. The letters are addressed to "My dear Molly," apparently one of the "Grandmother's" daughters, and each one describes a part of the charming house of (we assume) another daughter, who enjoys life under the Christian name of Margaret. The house is situated at Highfield, London. Of course labour-saving, cleanliness, economy, and efficiency, and all else that will contribute to peace of mind and comfort so far as lighting and heating are concerned are found in this desirable residence; and old-fashioned but open-minded grandmother is bound by her experience there to applaud gas modernization. Another handy little booklet for gas consumers is excellent, and should have a large sale, and an equally large influence—not only among those who are already gas consumers, but among those who are not. Coke is not overlooked; and a reprint of a short article from the "Westminster Express," on "Coke and Economy," will be found very serviceable.

Fuel Economy and Furnace Efficiency.

In the final paragraph of the leaflet last mentioned—"Coke and Economy"—those who are interested are asked to communicate with the London Coke Committee (No. 39, Victoria Street) for full particulars as to the economical and useful way of utilizing gas coke for household purposes. Just as this suggestion was being read, there came from the London Coke Committee (whose motto is "Coke and Economy") an attractive pamphlet "Fuel Economy and Furnace Efficiency," or "Moments with a Fuel Expert." There are eight pages of this; and the quality of the subject-matter may be gathered from this extract:

> Gas coke is giving satisfactory results in firing hundreds of boilers in London and the Provinces, while some electric power stations have used no other fuel for years. They are evaporating up to 9 lbs. of water per pound of coke, and their flue gases are 15 per cent. to 18 per cent. CO_2 under ordinary everyday conditions. In well-conducted power plants where bituminous coal is used, 12 per cent. to 14 per cent. CO_2 in the flue gases is often obtained; but in most cases 8 per cent. to 9 per cent. would represent a fair average, while the maximum attainable is about 16 per cent. Assuming the higher figure to represent the normal working efficiency of the average boiler furnace, even this may be improved by the adoption of a fuel lacking the dual characteristics of bituminous coal.

ELECTRICITY SUPPLY MEMORANDA.

A REVIEW of the "developments" in the electrical industry during the past year, from the pen of Mr. J. Horace Bowden, the Electrical Engineer of Poplar, has appeared in the "Electrical Times;" but our friend has been trying to make bricks without straw, for the general tenor of his article is to the effect that there have been no "developments" that deserve the name. And evidence from other quarters serves to confirm this. However, Mr. Bowden has not written in vain, for he is a progressive, a Point-Five, and a tariff idealist and reformer, and what he says has interest, and is written in an attractive manner. Right at the outset, he admits, without coating the pill, that it is perhaps somewhat difficult to point to any special feature in engineering practice appertaining to the year that will materially assist progress towards the universal use of electrical energy for power, light, and heat. It is a matter of passing interest to note the order in which the applications of the energy are placed. Power comes first, and heating last, with lighting between. Mr. Bowden gives early consideration to the use of gas plant, with bye-product recovery (as at Accrington), as being one of the most revolutionary steps in electricity supply; and he is looking eagerly for the tale that Accrington will have to tell regarding mature experiences. But he throws a new light on this business. He fears for the future of the bye-products. The large use of gas for the production of electrical energy would, he thinks, greatly increase the supply of the bye-products; and, under the commercial law of supply and demand, this would tend to decrease market values. Therefore, it would not do to base net generating costs on a limited experience at the early stages. Beyond this, the making of bye-products by carbonizing coal in gas producers would, he points out, soon bring the electrical industry into competition—apparently with the gas industry—not only in the matter of the staple commodity, but in the secondary ones. Of course, there is a way out of this, if the gas industry is given a larger freedom in gas production, and that is by leaving the gas industry to provide a good clean gas of respectable calorific power, such as is suitable for use in the cylinders of gas-engines, and taking over electricity undertakings as customers where economical relations are possible between gas production and electrical generating station demand. There is, however, another aspect of the matter of which Mr. Bowden should not lose sight. He touches upon it lightly in the words: "As the use of elsctrical energy for cooking and heating purposes is increased, a corresponding decrease in the use of gas will be experienced." As some ultra-enthusiasts in the electrical industry believe that the domestic cooking and heating work of this country is going to be done in future by the grossly inefficient process of obtaining heat by electrical agency, so much less gas will have to be produced by the gas industry, and therefore so much less in the way of secondary products. Therefore, if Mr. Bowden accepts the view of the assertive electrical prophets, he will see that there is no ground for alarm on the score of the over-production of sulphate of ammonia, tar, and other things, because the loss of the cooking and heating load to the gas industry will help to maintain the balance of things in regard to the yield of bye-products on the electrical industry adopting bye-product gas producers. There will, in fine, be merely a transfer to the electrical industry of the whole business in cooking and heating and bye-products. It is all so simple that it is to be wondered at that such a discerning man as Mr. Bowden had not seen this before.

Gas Driving, and Bye-Products.

Slow Progress.

However, when Mr. Bowden comes to examine dispassionately the position of the electrical cooking and heating business, he is obviously not altogether satisfied. He says that the load does not as yet present such favourable indications as power supply. Progress, he declares, has been made in a marked degree during the past twelve months in the design of apparatus; but—"buts" are most useful for toning-down things, and safeguarding

oneself—"much greater progress must be made before electricity can supersede gas for these purposes in entirety." The time has not therefore arrived for the gas industry to wear a dejected face. While on this subject, Mr. Bowden makes reference to the two distinct lines on which the construction of electric cookers is proceeding. There is what appeals to us as the biscuit-box type of construction, which, in the days of the youth of the cooker, has perhaps a rather higher heat efficiency than the stronger and heavier form of cooker; and there is the stronger and heavier form, which has longer life. Mr. Bowden seems prepared—looking at the matter from both the central station and the householder's points of view—to put his money on the latter type. Our knowledge of users' experiences extends to both forms; and we are inclined to agree with Mr. Bowden, who is supported by Mr. Seabrook, and other distinguished electrical engineers who, we are aware, have had a little difficulty with some householders whom they have persuaded to try electrical cooking, using certain types of apparatus. Mr. Bowden is evidently not going to allow himself to beat the big drum as have some of our electrical contemporaries without he sees a very solid reason for doing so. As yet he cannot detect such a reason. "It is," he remarks, "to be regretted that the past year has not produced a cooker with a heating element capable of boiling breakfast water within a reasonable time. There is promise of this being overcome shortly; but until this is an established fact, and the cost of manufacture is considerably reduced, progress in electric cooking will be retarded." Then he proceeds to confess that little or no progress appears to have been made in hot-water supply by electrical means during the past twelve months; and to him it seems doubtful whether the sphere of usefulness of electricity supply can be extended to this important requirement. This is precisely what we have said more than once lately; but to have Mr. Bowden saying it is rather blighting to the enthusiasm of those gentlemen who have brought out some wonderful designs of electrical water-heaters, which vie with the snail for alacrity in performance. The descriptions of these things and their inefficiencies certainly help to lighten the pages of some of our electrical contemporaries.

Confirmation. Commenting on its annual tables, which statistically show the position of the electricity supply industry, the "Electrician" acknowledges that it cannot apply the word "rapid" to the progress that is being made. It points out that in too many towns the kilowatts that have been added to the connections are quite small compared with the number that ought to have been added; and in many cases the connections have remained stationary. Our contemporary fancies that it detects a want of effort in trying to advance to a domestic and industrial era. The fact that stagnation appears to equally exist under both private and municipal ownership ought to do something to dispel the idea of lethargy. It quotes Marylebone as an instance of what can be done, and endeavours to disarm the criticism as to this being an extreme case, by saying that "Success follows effort." But there is one thing that effort cannot do, and that is to change the character of communities.

A Marylebone Curve. The paper last referred to publishes some curves from Marylebone for Jan. 1, 1912 1913, and 1914, for comparison purposes and it is intended that in this curve those who study it should find the wonderful effect of the heating load during the day time. The temperatures on the three days were respectively 49° Fahr., 45° Fahr., and 34·9° Fahr. The days in 1912 and 1913 are described as fair, and on Jan. 1 last as light. Now if we read this curve correctly, it shows distinctly a business establishment demand; and we are not by any means persuaded by it that it indicates any rapid growth of a heating load for domestic purposes. The highest point in the daylight part of the curve is at noon; and there is a gradual ascent to that from eight o'clock. The difference between the height of the curves at noon on Jan. 1, 1913, and Jan. 1, 1914, is roundly 1500 kilowatts; but that is only for about an hour and a quarter. Then shortly after 12 o'clock, there is a rapid recession of the curve until nearly two o'clock. We see no cause for the recession, unless it be that numerous lamps are shut off in business establishments during the midday dinner hour, or, as an alternative, the daylight peak may be due largely to the cooking in the business house of Debenham, and in those restaurants run as advertisements of special types of electric cooking apparatus. After two o'clock we get a sharp ascent of the curve until top point is reached between four and five o'clock. Then between six and eight o'clock the curve makes an acute descent again, until by eight o'clock it is down to the level of noontime consumption, and by ten o'clock the consumption is equal to the level of that at 10 o'clock in the morning. All this suggests a heavy shop and business house consumption, and not an extraordinary domestic heating consumption. Surely if there was a big domestic heating load, at eight o'clock in the evening—with the thermometer standing low and the domestic lighting and heating and street lighting in full swing—the curve ought to run higher than at noon on the same day. In the remarks in our contemporary on the curve, it is also observed: "The increase in the night load [that, is, between twelve midnight and six in the morning] is also very noticeable, and is due to heaters in bedrooms being left on all night." Has our contemporary inquired how much of the increase is due to the conversion of the street-lamps from gas to electricity, and to the use of higher power metallics because those originally put in in some streets gave rise to much indignant remonstration.

"The Honest Injun." Curiously enough, our esteemed contemporary the "Electrical Review" also simultaneously discusses in a special article the question of the use of electricity in the home, and with marked profundity, as is strikingly illustrated by the opening statement, that the most conservative institution in this country is the home. It goes on to show that, although conservative, Home Rule is very dominant under the cast-iron premiership of the householder's wife. What is therefore wanted for the development of the domestic side of the electricity business is the awakening of preliminary interest in the lady heads of our households. But our contemporary fears that the present modes of setting about the work in the electricity industry are not equal to the awakening task. It is thought that one of the best means of stirring up interest is to employ a lady canvasser, because she can talk as "one honest injun to another honest injun." The qualifications put forward for this lady canvasser are that she should "have some rudimentary knowledge of the application of electricity to heating and cooking. But inasmuch as a sale must not be approached from the point of view of technical electricity, but from that of modernism in the home, the technical aspect has to be kept well in the background, and hence knowledge of the things that appeal to a lady in her home is far more important than a most thorough comprehension of physical laws applied to heating elements." We are not sure that we altogether agree with our contemporary. For from experience in interrogating some of the ladies who have sought to qualify for "awakening preliminary interest" in domestic heating and cooking by electrical energy, we have come to the conclusion that a little more technical knowledge, and more intimacy with physical laws, would help to keep their tongues from uttering things that are not strictly in accordance with fact.

Wiring in Suburbia. On more than one occasion, observation has been made in the "Memoranda" on the character of the electric wiring put into some middle-class houses in the suburbs; and the prediction has been made that there will, in the days to come, be considerable trouble when the installations have been subjected to depreciation. A correspondent in the "Electrical Review" writes very pointedly on the jerry wiring that has come under his notice; and as he is an electrical man, his criticisms help to remove from us the charge of prejudice in respect of comments previously made. He says that in a house in its carcass state, fitted with between nine and fourteen lights, in some cases the casing is used without capping, reversed to the joist, leaving the wires at places absolutely uncovered. The wires that drop to the switches are encased in slip-joint tubing, buried behind plaster, leaving generally a gap between the end of the tube and that of the casing, the wires not being encased. Other places being a little awkward, the wires are run behind the laths without casing or tubing. The correspondent thinks the time has come when this sort of work should be condemned, as well as those who are responsible for it, as it is not only dangerous but detrimental to the electrical trade generally. He might have added, "and is to the ultimate advantage of competitors."

Dimming Lights. There is one advantage gas possesses that electric light has not got, which is that the light can at will be increased up to a point with any given burner (or decreased). There have been crude attempts to get the same convenience in connection with electric lamps; but there has not been anything produced that is at all striking. The systems tried have been (says the writer of "Installation Topics" in the "Electrical Times"): (1) By the use of special dimming switches; (2) by the use of double filament lamps, controlled by fixed switches at the wall, by turning the lamps in their holders, or by pulling cords which actuate a crude form of switch in the lamp cap; or (3) by placing two or more lamps of ordinary pattern in series. As the writer says, dimming switches are convenient in certain circumstances, for the volume of light can be varied over a wide range; but with the exception of the transformer type of dimmer, which is available, of course, only for alternating current circuits, these devices cease to work satisfactorily sooner or later, and, in any case, are not economical, for they merely introduce resistance in the circuit, and, though a dim light is secured, the watts consumed are out of proportion to the useful candle power obtained. Double-filament lamps are little used nowadays. In the carbon filament days, they enjoyed a certain amount of popularity; but their convenience is more than counterbalanced by their inefficiency. In most patterns the "baby" filament, giving 1 or 2 candle power, is placed in series with the main filament (rated at say 16 to 32 candle power) when a dim light is required. The main filament may reach a dull red temperature, but gives out practically no light—the "baby" filament glowing brightly, but taking anything up to 15 watts for the 1-candle power produced. Wire lamps with double filaments have been made, but introduce undesirable complications on account of the length of filament to be accommodated, and such lamps are seldom, if ever, met with in practice. All this is damning to the systems of dimming. On the whole, the writer concludes that the most satisfactory method of securing dim light control with electricity is by wiring the required circuits so that, by the use of

suitable switches, the lamps may be placed in series or parallel. But the description that follows of how it is to be done is not very convincing as to permanent effectiveness.

Always Trouble.

There is widespread trouble as to the use of electricity in factories and mines. Those who are supposed to know all about the official regulations for the installation and use of electricity in such places manifestly have not taken the trouble to master them, and police court proceedings are now frequently resulting. Some strange evidence as to the Senghenydd mine disaster was given at the inquest on the bodies of the victims; and it has been admitted that bare live wires were in use in the mine. Mr. Nelson, the Home Office Electrical Inspector, with a number of mining and electrical engineers, has been carrying out some experiments at the New Tredegar Colliery, by which it has been proved that coal gas or fire damp may be ignited by sparks in mines from the electric signalling cables used in the main hauling roads underground. The result of the Senghenydd inquiry is that the jury has been unable to decide whether the explosion was due to sparks from the signalling wires, or to the use of a naked light in the lamp room. Then there is the Dockyard fire at Portsmouth. The buildings destroyed were electrically lighted; but the cause of the fire remains a mystery. The jury who heard the evidence at the inquest on the victims in this case came to the conclusion that the fire was not due to the fusing of electric wires, nor was it brought about by coal gas or smoking; and the evidence was not sufficient to say that spontaneous combustion was responsible. No trail of Suffragettes was found. Then what was the cause?

COKE-OVEN GAS FOR TOWN SUPPLIES.

Review of the Question by M. Grebel.

In the last number of the "Journal" (p. 87), we gave an indication of the scope of M. Grebel's first article on the above subject in the "Génie Civil." We have now to deal with the second instalment.

The author takes up the subject of the distribution of gas to a distance by "boosting." He refers to what has been done in America in the case of natural gas, which has been utilized on that continent since 1821, and then gives some particulars of the progress made in Europe. The first distribution of high-pressure gas took place in 1903, in the valley of the Swiss Rhine, above Lake Constance, where the small commune of St. Margrethea was connected-up with eight others, representing a total of about 18,000 inhabitants. This installation served as a model for several others which rapidly succeeded it. In Germany there are at present 36 systems of distribution, supplying 105 localities, of which some have relief holders, and others are provided with gas-works serving places in their neighbourhood. These instances of the conveyance of gas to a distance, which represent a total delivery of about 4400 million cubic feet per annum, are at present only of average importance, as it is generally a question of supplying from one tolerably large works a number of places which are too small to justify the building of new works or the reconstruction of those which are inadequate. The author cites as instances the supply of Travemünde, from Lübeck, a distance of 15 miles, dating from 1903, the distribution of gas to places round Heidelberg, commenced in 1906 and 1907, and in the vicinity of Obersthausen in 1908.

The first instance of the conveyance of gas to a distance in France was brought into use in 1905. It was that of Fin d'Oise (near Andrésy) at Triel, to the west of Paris. The author is able to speak with special knowledge of this installation, as he was himself associated with it on behalf and under the direction of M. Mallet; and he gives a number of instructive details of it, accompanied by a diagram, showing the arrangement of the plant. Another instance of the long-distance delivery of gas is that of the Société d'Eclairage, Chauffage, et Force Motrice, who supply the principal suburbs of Paris. This is ordinary coal gas, and it is sent from the works at Gennevilliers under high pressure, and then stored in works at Boulogne-sur-Seine and Alfortville. Particulars of this installation were given in the "Journal" some time ago. In 1907 a small scheme for the delivery of gas between Guérande and Le Pouliguen was completed; and since 1908 one between Pézenas and Montagnac, similar to that at Fin d'Oise (4¼ miles), has been in operation. A more important installation, finished in 1907, connects La Croix-Rousse to Lyons and Neuville-sur-Saone. Since that date some companies, like the Société St. Quentinoise d'Eclairage, have commenced the supply of gas at a distance, notably in the neighbourhood of Chantilly; but this kind of installation has not progressed very rapidly in France.

In Germany, however, the supply of coke-oven gas has extended considerably. It is only about thirteen years since the first attempts in this direction were made. In 1905, Herr Hugo Stinnes furnished a supply of gas to the town of Essen (Ruhr) from his coke-ovens at the Gustave mines. At first, at both Essen and Mülheim there was mixed with the gas produced from the local works an increasing proportion of coke-oven gas; but when confidence was felt in the quality and certainty of delivery of the latter, the contracts for its supply became more numerous. Since 1907, Gelsenkirchen and the neighbouring towns, served by the Gesellschaft für Gas und Elektricität of Cologne, have been supplied from the Rhine-Elbe coke-ovens, under a contract for twelve years entered into between the above-named Company and the Gelsenkirchener Bergwerks-Aktien-Gesellschaft, with an annual output of about 353 million cubic feet. As from April, 1911, the town of Barmen decided to receive exclusively from the coke-ovens at Hamborn, near Duisbourg, the whole of the gas required, amounting to between 670 and 706 million cubic feet per annum. In this case the gas had to be conveyed a distance of 30 miles. Following upon the decision come to by Barmen, Essen and Mülheim closed their gas-works; Bochum only uses gas from the coke-ovens at the Krupp works; also Hanover and Hannibal, situate about 3⅜ miles from the municipal gas-works, with an annual output of close upon 265 million cubic feet. Other places, with the approval of the Council of the Rhine Province, are now supplied exclusively with coke-oven gas.

M. Grebel next proceeds to study technically and economically the general question of the conveyance of gas to a distance. It appears that, towards the close of the concession granted to the old Paris Gas Company, the Government instituted an inquiry into a project for the supply of the city with gas to be made at the coke-ovens of the North and of the Pas-de-Calais, and conveyed to Paris in mains upon which there were several "boosting" stations. The author reviews the proposal made in 1906 by Mr. Martin to supply London with gas produced in Yorkshire, at a distance of about 170 miles from the area of consumption. This would have necessitated an initial pressure of 36 atmospheres. Two inconveniences present themselves under such conditions—viz., condensation of the heavy hydrocarbons, and leakage. With regard to the former, M. Grebel points out that experience has shown that the illuminating power of gas is not appreciably reduced unless the pressure rises above 6½ lbs. per square centimetre (0·155 square inch); while the calorific power is not lowered even at these high pressures. With regard to leakage, however, there is more cause for fear, inasmuch as the fluid conveyed is a light one. M. Grebel considers that, from the point of view of soundness, it is advisable to employ steel pipes from 32 to 40 feet long, in order to reduce the number of joints, which are a source of leakage from cast-iron pipes. The author deals with this subject at some length, and gives diagrams of joints for both cast-iron and steel pipes.

The question of pipe-jointing has been much discussed of late. At the last meeting of the Société Technique du Gaz en France, M. Busine, a Belgian gas engineer, stated that in coal-mining countries, where the pipes sometimes drop 3 feet in ten years, 6 ft. 6 in. lengths, with india-rubber joints, are preferable to long steel pipes. With these small-size pipes bosses and hollows are formed; but there are no disjointings. At times there is very great leakage, arising from fractures of the pipes, but never on account of the india-rubber joints. M. Grebel is of opinion that lead joints cannot lend themselves to the inflexions in the canalization, and consequently he prefers to use rubber joints.

The calculation of the loss of head is of primary importance in determining the diameter of mains. M. Grebel has made a special study of this subject; and he refers to the *abacus* he produced a few years ago to determine rapidly one or two of the four elements concerned—viz., output, diameter, loss of head, and rate of flow—in function of the two others. This *abacus* was reproduced in the "Journal" for April 11, 1911 (p. 104); and the author says it may be safely employed for pressures below 13 to 16 feet of water, and for diameters less than 8 to 12 inches, to find losses of head higher than the actual losses with coal gas of ordinary density. For high pressures and large diameters, however, he thinks it would be better to have recourse to more modern formulæ, which, he regrets, there have not as yet been opportunities of practically verifying a sufficient number of times on the Continent.

With these observations the author closes his second article.

Yorkshire Junior Gas Association.—We learn from the Hon. Secretary (Mr. Edward Garsed) that the next meeting of the Association will be held at the Bradford Municipal Technical College, next Saturday afternoon, when Mr. Twigg, of the Davis Gas-Stove Company, will give an address on "Gas-Fires in the Light of Recent Research."

Institution of Civil Engineers.—At the meeting of the Institution last Tuesday, Mr. Arthur Rodney Burch, the Engineer of the Bombay Gas Company, was admitted a member, and Mr. John Arthur Badwell, of the Engineer's Department of the Belfast Water-Works, an associate member. On the same occasion, it was reported that Mr. Frederic John Dixon, the Engineer-in-Charge and Manager of the Ashton-under-Lyne and District Water-Works, had been transferred from the class of associate member to that of member.

Reports of Gas Associations for 1913.—As announced in another part of the "Journal," this work is now ready. The volume contains the collected reports, as given in our columns, of the proceedings at the meetings of the various District Gas Associations held in the past year. The technical matter occupies 474 pages, and is illustrated by 37 figures and a number of diagrams. Reference to any subject is facilitated by an index; and at the end of the book are given lists of the officers and members of the Associations. The volume, which is the thirty-first of the series, will form a useful companion to the "Transactions" of the Institution of Gas Engineers.

GAS BILLS FOR 1914.

[Third Article.]

In this article the review is completed of the Bills deposited by statutory gas companies for promotion in the coming session.

The Kidsgrove Gas Company are making provision for the expansion which they, in common with gas undertakings generally, are experiencing. By their Act of 1871, the capital of the concern was fixed at £20,000, of which £9235 (in £10 shares) is entitled to a dividend not exceeding 10 per cent. per annum, and £10,760 (also in £10 shares) is entitled to a dividend not exceeding 7 per cent. The whole of the share and loan capital has been raised. The Company want to enlarge their works, and to construct a bridge over the Trent and Mersey Canal for the purpose of connecting their lands on either side of the canal. The Company are desirous that the limits of their supply (to be extended to include the parish of Old Rode) shall be defined in accordance with the Bill. Touching this matter, they propose to voluntarily relinquish any claim to so much of the parish of Audley as is situated beyond the limits of the ecclesiastical parish or chapelry of Talk-o'-th'-Hill, which is now supplied with gas by the Audley District Council; but portions of the area now served by the Company are within the gas-supply limits of the British Gaslight Company, Limited, who have not supplied any part of the district. It is therefore submitted that the rights of the British Company should be repealed. These particulars are gathered from the preamble; and clauses give effect to them. In connection with the land and works clauses, provision is made to stop up a footpath, and to construct the bridge already mentioned, and equip it with the necessary apparatus for transport. In this relation, nothing is to be done that will interfere with the telegraphic lines of the Postmaster-General. Compensation is to be paid to any owners interested in the lands over which the bridge or approaches are constructed. Then follow the clauses referring to the definition of the limits of supply as already mentioned. It is proposed that the standard quality of the gas shall be 13 candles; and, to take effect from Dec. 31 next, it is contemplated that the standard price shall be 3s. 3d. within the parishes of Kidsgrove and Hardingswood, and 3s. 6d. within the remainder of the limits of supply, provided that the price charged within the latter shall not exceed by more than 3d. the price charged in Kidsgrove and Hardingswood. The sliding-scale is to be adopted on the usual terms. Associated with the prepayment meter clause is one providing that any person who causes or suffers to be placed in any prepayment meter belonging to the Company any disc, token, coin, or thing other than a coin of the value and denomination for which the prepayment meter is designed shall be liable to a penalty not exceeding twenty shillings. A stand-by clause referring to both gas and electricity is included. A number of clauses of normal character succeed. In regard to the financial provisions, the Company ask for power to raise £25,000 of additional capital, of which not more than £12,000 is to be issued as preference stock. On the portion of the additional capital issued as ordinary, the standard rate of dividend is to be 7 per cent., and on the preference capital 6 per cent. Concerning borrowing powers, the Company desire sanction to the raising of £6666 in respect of the 1871 capital, including the £5000 already borrowed; and in respect of the additional capital, the equivalent of one-third part of that issued. Clauses establishing the right to putting into force a profit-sharing scheme also appear. [*Parliamentary Agents: Messrs. Lees and Co.*]

The Leighton Buzzard Gas Company are desirous of extending the limits of their supply, and raising additional capital. By their Act of 1891, the capital authorized was defined as consisting of £12,106 10s. original capital, and £15,000 additional capital. The whole of the original capital has been raised, as well as £13,001 8s. by the creation and issue of £9750 new ordinary stock of the additional capital. The Company have power to raise a further sum of £1998 12s. The Company have not exercised any of their borrowing powers under the Act of 1891. They are purposing the conversion and consolidation on a 5 per cent. basis. It is also submitted that, there being due to the shareholders in respect of dividends not previously paid in full a sum of £1813, it is expedient that provision should be made with respect to the distribution of such sum. Among the first clauses is one arranging for an extension of the limits of supply to certain places in the counties of Buckingham and Bedford, in which places the Company desire to be authorized to charge a price not exceeding by more than 6d. the price for the time being charged in the existing limits. In regard to the capital consolidation scheme, the Company propose conversion into consolidated ordinary stock to the nominal amount of £37,863, bearing a uniform dividend at the rate of 5 per cent. In other words, "the £12,106 10s. of original stock will be converted into £24,213, and the £9750 of new ordinary stock into £13,650—the holders of the original stock to receive for every £100 at present held £200 of consolidated ordinary stock, and the holders of new ordinary stock for each £100 the sum of £140 of consolidated ordinary stock. The Company request to be empowered to raise £10,000 of additional capital, and to issue any capital authorized by the Act of 1891, and not raised as preference capital, as consolidated ordinary stock. Then follows the provision as to the payment out of the reserve fund of the dividends to which the shareholders were entitled, but which were not paid. In respect of the consolidated stock and issued additional capital, the Company ask for borrowing powers to the amount of one-third. The standard price is put at 3s. 6d., with the sliding scale operating on the usual conditions for 5 per cent. stock. It is intended that the standard of illuminating power shall be extinguished, and a calorific one on the lines of the South Suburban model shall be adopted; but it is proposed that the apparatus used "shall be that which is most suitable for ascertaining, and in making the test shall be used in such a manner, and under such conditions, as to ascertain, after any necessary calculations have been made, the total heat value of the gas." Within a month after the expiration of triennial periods, application may be made to the Board of Trade for a variation of the standard. Included in the Bill is a stand-by clause covering both gas and electricity. The remaining clauses are in customary form. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Leyland Gas Company are desirous of extending their opportunities, and of adding to their business that of electricity supply. By the Company's Act of 1902, the shares were consolidated into stock, and by that Act and the Act of 1909, it was provided that the capital should be £69,800, whereof the Company have raised £40,136 16s., by the issue of £37,800, entitled to a maximum dividend of 5 per cent., and £2000 of 5 per cent. preference stock. The borrowing powers amount to £11,250; but no part of this has been raised. The Company, under the altered circumstances, desire to change their name to the Leyland Gas and Electricity Company. The additional parishes it is sought to include in the area of supply are Longton, Bretherton, Little Hoole, Much Hoole, Tarleton, and Hesketh with Becconsall. There is, in this connection, a provision to empower the Company and the Preston Gas Company to enter into agreements for defining and varying the boundaries between their respective limits for the supply of gas; but nothing in the proviso is to operate to extend the limits of either Company. After the lands and works clauses, there follow the provisions for substituting calorific value for illuminating power; and in the draft, while the expressions are the same as the South Suburban model, we get a variation from the figures—a matter to which reference was made in our editorial columns last week. It is proposed that the standard shall be 500 B.Th.U. gross per cubic foot, with penalties for deficiencies below 410 B.Th.U. The clauses succeeding are intended to confer all the necessary powers regarding electricity supply; and they are of the ordinary form. The financial powers contemplate the raising of additional capital not exceeding in the whole £60,000, with one-third borrowing, and on the same scale with respect to the already authorized capital. Among the miscellaneous clauses is found this unusual provision: "For the purposes of section 29 of the Act of 1909, the price charged by the Company in any year shall be deemed to be the average of the prices per 1000 cubic feet charged by the Company in respect of all gas supplied by them during such year." A stand-by clause in respect of both gas and electricity is included, and protection is proposed to be obtained against users of gas or electrical energy for intermittent periods which would jeopardize the general supply. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

In our issue for Dec. 23 (p. 955), the Bill of the Liverpool Gas Company was reviewed; and therefore there is no call to repeat the information then given. The principal features are an extension of the limits of supply, the provision of additional capital, and the substitution of a calorific standard for the illuminating power one. The calorific power is to be measured so as to ascertain the "total heat value" of the gas. [*Parliamentary Agents: Messrs. Rees and Freres.*]

The Longwood Gas Company are proposing the purchase of the Slaithwaite Gas Company, and the obtaining of further powers. The issued capital of the promoting Company is £5000 consolidated preference stock, entitled to a dividend of 4 per cent. per annum, and £70,400 consolidated ordinary stock, entitled to a standard dividend of 5 per cent. per annum—the dividend being subject to variations according to increases or decreases from the standard price of 3s. 1d. The present price is 2s. 6d. per 1000 cubic feet. The Company have borrowed £23,873. The issued capital of the Slaithwaite Company is 1000 preference shares of £10 each, bearing a preferential dividend of 3¾ per cent.; 770 fully-paid shares of £10 each, entitled to a maximum dividend of 10 per cent.; and 1250 shares of £10 each, of which £2 per share has been paid up, entitled to a maximum dividend of 10 per cent. per annum. The Company have borrowed £3600. The price charged for gas in Slaithwaite is 2s. 11d. Turning to the clauses of the Bill, it is seen that the consideration in respect of transfer is the issue to each holder of fully-paid shares in the original capital of the Slaithwaite Company for every share held the sum of £20 of consolidated stock in the Longwood Company; and to the holders of partly-paid shares in the original capital of the Slaithwaite Company, for every share held, £4 of consolidated ordinary stock in respect of the £2 paid up on such shares before Dec. 1, 1913, and £1 of stock in respect of each additional £1 paid up before the date of transfer. Holders of preference shares, for each one, are to receive £10 of consolidated preference stock. After the transfer, the provisions of the Longwood Acts are to apply to the Slaithwaite area, but certain of the Slaithwaite provisions are also to continue in force. The Longwood Company propose to raise, as additional capital, a sum not exceeding the amount of the original capital of the Slaithwaite Company which has not been paid up, by the creation and issue of consolidated ordinary stock or preference stock. "Any stock issued by the Company pursuant to this section may be offered to the holders of partly-paid shares in the original capital of the Slaithwaite Company, at its nominal value, and any such stock which, having

been so offered, is not accepted shall be issued subject to, and in accordance with, the provisions of the Longwood Gas Act, 1902, regulating the issue of additional capital of the Company." Three of the Directors of the Slaithwaite Company are to go on to the Board of the Longwood Company. This will temporarily increase the number of Directors to nine; but the first three vacancies after the transfer, due to death, resignation, or vacation of office otherwise than by rotation, are not to be filled. The prescribed remuneration of the Directors is to be raised from £250 to £450. Arrangements are made for Mr. John Furniss, the Secretary, Engineer, and Manager of the Slaithwaite Gas Company, to pass into the service of the Longwood Company; and for an annual allowance or pension on the termination of his services. The promoting Company desire that their borrowing powers shall be in the ratio of one-third of the issued capital. Until Dec. 1, 1916, it is proposed that the price of gas in the Slaithwaite district shall not exceed by 5d. the price charged in the Longwood area; and after the date mentioned, an annual reduction of 1d. is to be made, until the difference is extinguished. In respect of any half year, the rate of dividend payable on the Slaithwaite stock is to be, for every 1d. charged above the price in the Longwood district, less by 1s. 3d. per cent. than the dividend on the Longwood stock. A stand-by clause referable to gas and electricity is included in the Bill. A provision follows allowing the price of gas to vary according to the purpose for which the gas is supplied, as may be agreed upon between the Company and the person taking such supply, "provided that the Company shall not, under the powers of this section, give any preferential price as between any consumers who shall take a supply of gas for the same purpose under like circumstances. The Company are also asking for the standard of illuminating power to be placed at 14 candles. In a subsequent clause, it is proposed that the name of the Company shall be changed to the Longwood and Slaithwaite Gas Company. Succeeding are provisions relating to the establishment of a co-partnership scheme. Among the miscellaneous clauses is one exempting the Company from any obligation to give from any main a supply of gas for any purpose other than lighting or domestic use in any case where the capacity of a main is insufficient for the purpose, or if, and so long as, any such supply would, in the opinion of the Company, interfere with the sufficiency of the gas required to be supplied by means of such main for lighting purposes. [*Parliamentary Agents: Messrs. Torr, Durnford, and Co.*]

The Rhymney and Aber Valleys Gas and Water Company have, owing to great colliery developments, experienced a considerable increase in demand for both gas and water. Consequently it is necessary to ask Parliament for further powers. In the deposited Bill, lands are described for both gas and water purposes, as well as lands for protecting the water-works against pollution, fouling, and contamination. Power is asked to the raising of additional capital to an amount not exceeding in the whole £150,000, to be entitled, on the part issued as additional capital, to a dividend of 7 per cent., and 6 per cent. on the part issued as preference capital. Borrowing powers to the extent of the usual one-third are desired. The Company also ask for the removal of the obligation to prepare half-yearly accounts. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

The Bill deposited by the Riddings District Gas Company proposes the acquisition of the Pinxton Gas Company, the changing of the standard of quality to calorific value, and the raising of additional capital. By the Company's Act of 1880, the original capital was fixed at £30,000, earning 10 per cent. dividend. The whole of the shares have been issued, and are fully paid up. By the Company's Order of 1903, they were authorized to raise additiona lcapital to the amount of £20,000. Exercising these powers, the Company have issued 894 preference shares of £10 each, entitled to 5 per cent. dividend. They were authorized by the 1888 Act to borrow, and have borrowed, £7500; and by the Order of 1903, they were empowered to borrow one-fourth part of the amount of the capital then authorized, and in exercise of that power they have raised £2250. The capital of the Pinxton Company consists of 1500 fully paid-up shares of £5 each. The first clauses of the Bill extend the limits of supply; and then follow those providing for the acquisition of the Pinxton Company. In consideration of transfer, it is proposed to issue to the holders of shares in the Pinxton Company, for each share, £5 of 10 per cent. ordinary stock, to pay £500 in cash (which sum is to be applied by the Pinxton Company in the winding-up and dissolution of the Company, and in payment of compensation to the Directors and officers, and to take over the stock at a price to be agreed between Mr. Benjamin Ely on behalf of the Riddings Company and Mr. W. H. Newton on behalf of the Pinxton Company. Following the lands and works clauses, the Company seek power to raise (in addition to the 10 per cent. ordinary stock created and vested in the holders of shares in the Pinxton Company) additional capital not exceeding in the whole £10,000, to be entitled to 7 per cent. dividend on the part issued as ordinary stock, and not exceeding 6 per cent. on the part issued as preference capital. In addition to the £7500 already borrowed, the Company desire to borrow in respect of the existing 1888 capital £5000; to raise the borrowing powers under the Order of 1903 from one-fourth to one-third; and further, to have the right to borrow up to one-third in respect of the additional capital raised under the present measure. There follow the clauses to substitute calorific value for illuminating power as the standard of quality. For testing, it is proposed that the apparatus "shall be capable of being, and shall be so used as to yield the total heat value of the gas expressed in B.Th.U." The standard and conditions are on the South Suburban model. The miscellaneous clauses include a stand-by one, covering both gas and electricity. [*Parliamentary Agents: Messrs. Rees and Freres.*]

The Southend Gas Company have a Bill in Parliament to authorize the purchase by them of the Leigh-on-Sea Gas-Works from the Southend Corporation, to extend the limits of supply, and for other purposes. The extension proposed is defined; and in this connection there is a stipulation that if at any time, after the expiration of five years from the passing of the Act, the Company have not laid down mains for the supply of gas within any parish or place mentioned, the local authority may apply for an Act or Provisional Order for the purposes of a supply. The Leigh-on-Sea undertaking is to be transferred on terms to be agreed, which terms may provide *inter alia* that, as part of the consideration to be given by the Company, they shall take over, in whole or in part, and indemnify the Corporation against, all liability in respect of the loan indebtedness of the Corporation in connection with the undertaking and of the interest accruing thereon. Land purchase and works clauses appear; and then the substitution of the illuminating power standard by the calorific value one is proposed. The conditions of the calorific clauses follow the South Suburban model. The Company ask to be invested with the right to raise £225,000 of additional capital. It is provided that, in the application of the provisions of section 43 (Dividend Dependent on Price Charged) of the Company's Act of 1898 to any capital raised under the provisions of the present measure, such provisions shall have effect as if the words 4s. were substituted for 4s. 3d. The borrowing powers proposed are on the one-third scale. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

The South Suburban Company have deposited a Bill to empower the acquisition of lands and the construction of works at Erith. In the preamble reference is made to the fact that the Company, under the powers of their Act of 1912, acquired the undertaking of the West Kent Company, the works of which at Erith are the only ones belonging to them which admit of the delivery of coal by water carriage, but they are not of a capacity or area suitable for economic development. The Company now therefore ask to be empowered to acquire lands adjoining the River Thames for the construction of works for gas manufacture and the generation of electrical energy, with wharf, jetty, railway siding, and all the necessary equipment. Power is taken to sell the existing gas-works at Erith. The Company also submit the expediency of being empowered to sell or dispose of any electrical energy generated by them. By their Act of 1912, there were created 4 per cent. debenture stock to the nominal amount of £15,000, and 3½ per cent. debenture stock to the nominal amount of £55,000. It is asked that these debenture stocks be converted into 5 per cent. debenture stock, to the intent that all the debenture stock of the Company shall form one and the same class, and bear a uniform rate of interest. Each holder of 4 per cent. debenture stock is to receive, for every £100 held, £80 of 5 per cent. stock, and every holder of 3½ per cent. debenture stock is to receive, for every £100, £70 of debenture stock. The restriction imposed on the Company at the instance of the chemical manufacturers in 1912, in regard to dealings in residual products, it is proposed shall be repealed. Revision of the authorization as to the number of Directors is also contemplated. Independent of the Employee Directors holding office, the number of Directors, it is suggested, shall be not more than eight nor less than five. [*Parliamentary Agents: Messrs. Dyson and Co.*]

THE QUALITY OF LONDON GAS

In the Year 1913.

In continuation of the series of articles which have appeared from time to time in the "Journal," we give below summaries of the results of the official testings of the gas supplied by the three Metropolitan Companies during the fourth quarter of 1913, and a further summary for the complete year. The corresponding statements for the fourth quarter of 1912 and for the year 1912 appeared in the "Journal," Vol. CXXI., p. 237, and the more detailed separate statements for each of the first three quarters of 1913 in Vols. CXXII. (p. 235), CXXIII. (p. 228), and CXXIV. (p. 354). In all cases the results given refer to the testings made in the nineteen testing places which are under the control of the London County Council, and the summaries have been prepared from the weekly reports issued by that body.

FOURTH QUARTER OF 1913.

Illuminating Power.

The average results of the testings of illuminating power, made both with the standard argand (No. 2 "Metropolitan") burner and the prescribed flat-flame burner, on the gas supplied by the three Companies, are given for this quarter in Table I.

The figures for the corresponding quarters of 1911-12 are also given in the same table for comparative purposes. It will be seen that there has been very little change in the average results of the testings in the three quarters. The minimum return for the argand testings on the Gaslight and Coke Company's supply during the

TABLE I.—*Averages of All the Testings of Illuminating Power for the Fourth Quarter of the Year* [*Candles*].

Company.	No. 2 "Metropolitan" Argand.			Flat-Flame.		
	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke .	14·82	14·47	14·43	8·47	8·17	8·15
South Metropolitan.	15·69	15·52	15·57	9·81	9·44	9·42
Commercial . . .	14·65	14·88	14·46	8·43	8·36	7·66

quarter was 13·18 candles. In four weeks of the quarter there were returns below 13½ candles on this Company's gas; but the data given in the weekly reports issued by the County Council do not show whether these low returns may not have been compensated for by the returns the preceding and following days having been so far above the required standard that the average for the three days' testings will have been above the 13½ candle limit. The Company are liable to incur a forfeiture if the results of three consecutive days' testings give a mean below 13½ candles. In all the weeks of the quarter returns below 14 candles are recorded for this Company. The minimum return for the argand testings on the gas supplied by the South Metropolitan Company was 14·05 candles. The corresponding minimum for the Commercial Company was 13·78 candles. In three weeks of the quarter this Company had returns below 14 candles.

The minimum results reported for the flat-flame testings made during the quarter were: For the Gaslight and Coke Company 6·36 candles; for the South Metropolitan Company, 7·54 candles; and for the Commercial Company, 6·62 candles.

CALORIFIC POWER.

The average and the maximum and minimum figures reported for the testings of calorific power made during the quarter are shown with the corresponding figures for the fourth quarters of 1911-12 in Table II.

TABLE II.—*Summary of Testings of Calorific Power* (*Gross and Net*) *for the Fourth Quarter of the Year* [*Calories per Cubic Foot*].

Company.	Average.			Maximum.			Minimum.		
	1911.	1912.	1913.	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke—									
Gross	137·1	136·1	136·5	149·5	145·9	161·6	129·4	128·7	128·1
Net	122·3	121·2	121·7	132·9	129·1	146·0	115·4	113·6	113·8
South Metropolitan—									
Gross	144·2	144·3	144·2	156·4	163·4	160·2	134·9	133·2	133·9
Net	128·5	128·5	128·3	140·6	145·8	143·4	119·7	118·4	118·8
Commercial—									
Gross	137·1	136·2	136·2	151·3	151·4	144·8	127·9	126·3	126·1
Net	122·3	121·9	121·8	136·6	136·5	130·8	113·9	112·2	111·4

It will be seen that in calorific power as well as illuminating power there has been very little change in the quality of the gas for the corresponding quarter for the past two years. The minimum figure reported for the Gaslight and Coke Company—viz., 113·8 calories net—is above the limit of 112½ calories—below which the gas supplied by the Company must not, according to Statute, fall, on the average of three consecutive days' testings. The Commercial Company, who had a minimum return of 111·4 calories net, are not under a corresponding statutory obligation in regard to the calorific power of the gas which they supply; and the minimum return for the South Metropolitan Company—viz., 118·8 calories net—is well above the standard which has been prescribed for the Gaslight and Coke Company.

SULPHUR.

Table III. gives the average and maximum figures reported for the testings for sulphur during the fourth quarters of 1913 and the two preceding years. The average for the South Metropolitan Company—viz., 25·1 grains of sulphur per 100 cubic feet—is somewhat lower than the average for the same quarter of the

TABLE III.—*Summary of Testings of the Sulphur in London Gas for the Fourth Quarter of the Year* [*Grains per* 100 *Cubic Feet*].

Company.	Average.			Maximum.		
	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke .	34·0	36·4	34·4	62·9	63·2	55·5
South Metropolitan	26·9	26·2	25·1	57·9	55·5	65·8
Commercial . . .	28·8	28·8	28 5	61 7	47·5	47·3

previous years, doubtless owing to the extension in the use of the Evans process of purification by the Company. The maximum return reported for the Company is, however, higher than the corresponding maxima in 1911-12.

RESULTS FOR THE COMPLETE YEAR.

ILLUMINATING POWER.

The testings of illuminating power for the last three complete years give the average figures shown in Table IV. So far as the

TABLE IV.—*Averages of All the Testings of Illuminating Power for the Whole Year* [*Candles*].

Company.	No. 2 "Metropolitan" Argand.			Flat-Flame.		
	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke .	14·90	14·52	14·40	8·59	8·25	8·18
South Metropolitan	15·70	15·49	15·51	9·90	9·38	9·44
Commercial . . .	14·60	14 89	14·61	8·47	8·43	8·22

statutory argand testings are concerned, there has been a drop of exactly half-a-candle in the illuminating power of the gas supplied by the Gaslight and Coke Company in two years; no change in that supplied by the Commercial Company; and a reduction of about one-fifth candle in that supplied by the South Metropolitan Company. The flat-flame testings throughout gave a rather lower average for 1913 than for 1911. Between 1912 and 1913, however, there is but little difference in any of the testings. The minimum returns for the argand testings throughout the year were: For the Gaslight and Coke Company, 12·36 candles; for the South Metropolitan Company, 13·70 candles; for the Commercial Company, 13·70 candles.

It may be interesting also to note the maximum returns throughout the year, which were: For the Gaslight and Coke Company, 20·73 candles; the South Metropolitan Company, 17·89 candles; the Commercial Company, 17·18 candles.

CALORIFIC POWER.

A summary of the results of testings of calorific power during 1913 and the two preceding years is given in Table V.

TABLE V.—*Summary of the Testings of Calorific Power* (*Gross and Net*) *for the Whole Year* [*Calories per Cubic Foot*].

Company.	Average.			Maximum.			Minimum.		
	1911.	1912.	1913.	1911.	1912.	1913.	1911.	1912.	1913.
Gaslight and Coke—									
Gross	137·5	135·3	136·1	153·4	148·6	161·6	127·8	123·7	126·6
Net	122·7	120·6	121·2	138·0	132·8	146·0	114·3	110·2	113·3
South Metropolitan—									
Gross	144·6	143·4	143·9	160·3	163·4	160·2	133·5	131·7	133·9
Net	128·9	127·7	128·1	144·5	145·8	143·4	119·0	116·6	118·8
Commercial—									
Gross	137·1	136·2	135·3	152·2	151·4	147·3	123·6	122 0	123·1
Net	122·4	122·0	121·1	135·8	136·5	132·7	110·0	112·0	110·7

These figures show that the average calorific power of the gas supplied by all three Companies has been practically the same in each of the three years, though on the whole there is a slight reduction in 1913 compared with 1911. There is also no noteworthy difference between the minimum returns for the same Company in each of the three years. On the whole, consumers seem to have received rather more calories per cubic foot in 1913 than in 1912; but it must be borne in mind that the 1912 figures were appreciably affected by the effect of the miners' strike on the supply of coal in the early part of that year. The neat coal gas supplied by the South Metropolitan Company continues to be higher in illuminating power by fully one candle, and in calorific power by about 7 calories per cubic foot, than the mixed gas supplied by the other two Companies. In respect of fluctuations of quality, as judged by the maximum and minimum results, there does not appear to be much to choose between the neat coal gas and the mixed gas supplies.

PURITY.

The gas supplied by each of the three Companies has been found to be free from sulphuretted hydrogen throughout the year. The average and maximum results of the testings for sulphur in other forms are given in Table VI.

TABLE VI.—*Summary of Testings of the Sulphur in London Gas for the Whole Year* [*Grains per* 100 *Cubic Feet*].

Company.	Average.			Maximum.		
	1911.	1912.	1913	1911.	1912.	1913.
Gaslight and Coke .	34·0	34·8	35·7	62 9	63·2	62·2
South Metropolitan.	26·9	24·5	24·1	57·9	55·5	65·8
Commercial . . .	28·8	27·5	28·7	61·7	47·5	54·7

This shows a slight rise in the average proportion of sulphur in the gas of the Gaslight and Coke Company, a slight reduction in that of the South Metropolitan Company, and no appreciable change in that of the Commercial Company. The maximum figures do not call for comment.

PRESSURE.

There have been 27 observations of pressure in the year 1913 in the districts of the three Companies; and the lowest reading was 31-10ths. The results reported are summarized in Table VII.

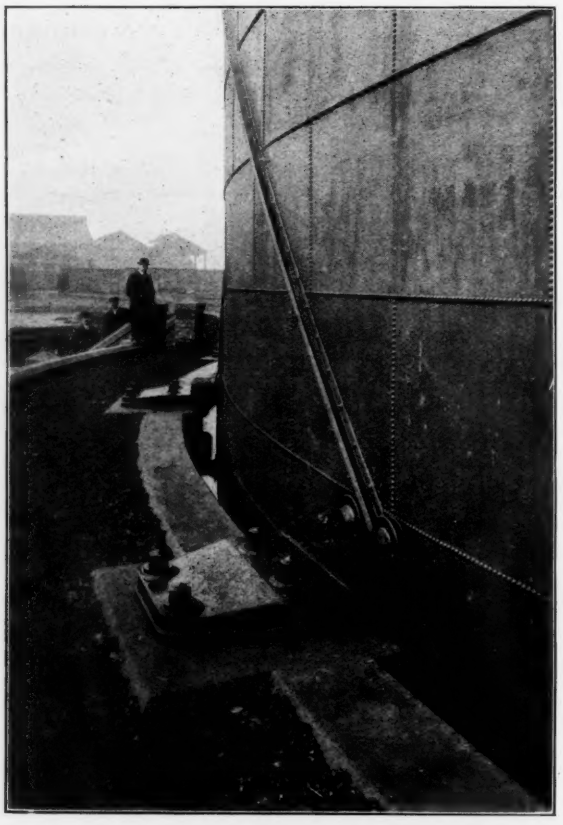
It is obvious that the pressure has everywhere been maintained far above the statutory minimum of 6-10ths by day and 10-10ths by night.

TABLE VII.—*Maximum and Minimum Results of the Testings of Pressure in* 1913 [*Tenths of an Inch*].

Company.	No. of Testings in the Year.	Highest Pressure Observed.	Lowest Pressure Observed.
Gaslight and Coke	17	Over 40	33
South Metropolitan	8	Over 40	31
Commercial	2	39	37

THE RE-ERECTED HOLDER AT ILKESTON.

ARRANGEMENTS have been made for the re-erected gasholder at Ilkeston to be formally inaugurated on Thursday; and, in view of this, it will be of interest to reproduce a photograph (taken by Mr. Samuel Kirk, of Notingham) showing a portion of the brick-and-puddle tank which has been adopted in place of the steel one a weakness in certain plates of which was found to be the cause of the unfortunate accident in January, 1912.



The Scottish Junior Gas Association (Western District) will next Saturday visit the Glasgow Corporation Stove and Meter Workshops, in Walls Street. The next ordinary meeting will take place in the Glasgow Royal Technical College, when papers will be read by Mr. D. T. Marwick (Temple Works) on the "Heating of Retort-Settings," and by Mr. William Wilson (Falkirk) on an "Experience in Distribution." An invitation is extended to the members of the Association to be present at a paper which will be read at the College on the 27th inst., under the auspices of the Society of Chemical Industry, by Mr. H. Beilby, on the "Low-Temperature Carbonization of Coal."

This Year's Meeting of the German Association.—It is announced that this year's meeting of the German Association of Gas and Water Engineers, which was to have been held at Dortmund towards the end of June, will instead be held at Munich early in July. The change has been made (with the concurrence of the authorities at Dortmund) in view of the importance of the German Gas Exhibition which will be opened in Munich by its Patron, His Majesty King Ludwig the Third, early in July. The German Association meeting will be fixed to cover the opening of the exhibition, the exact date of which has not yet been settled. It will be remembered that the Association held its annual meeting at Munich only two years ago.

WORKS TOPICS—XVI.

By "Modus Operandi."

THE SOUTH METROPOLITAN PURIFICATION PROCESS.

THE enterprise of the South Metropolitan Gas Company and of their Chairman, Mr. Charles Carpenter, D.Sc., in investigating the question of the purification of gas from sulphur compounds is a matter which has from time to time been introduced to the notice of gas engineers. It is now re-introduced in the "Transactions" of the Société Technique de l'Industrie du Gaz en France, which have just been published. Readers will remember that Mr. Carpenter read a paper* on this subject before the Société at last year's annual meeting.

Most engineers in considering a process of this kind require to know three things—the initial outlay on the plant, the efficiency in working, and the cost of running. As to the first, we are told nothing; as regards the second, we are told enough to convince us of the undoubted success of the process; while, in the matter of daily working expenditure, the figure given is one that should appeal forcibly to the engineer who is, for one reason or another, committed to sulphur purification.

From the paper, it is seen that the cost of working is as follows:

Fuel	0·1477d. per 1000 cubic feet.
Wages	0·0381 ,, ,, ,, ,,
Interest, sinking fund, and repairs	0·1687 ,, ,, ,, ,,
	0·3545d. per 1000 cubic feet.

These figures do not tell us the initial outlay; but this we may hope to learn so soon as Mr. Carpenter is satisfied as to the practical perfection of the plant. It is, of course, understood that the development of such a process as this must have called for an immense amount of original research and pioneer work; so that it is probable that a good deal still remains to be discovered by gradual evolution.

The process appears to be wonderfully efficient, for, whatever the initial quantity of the sulphur compounds present in the gas, the amount on the outlet is very uniform and low. It is stated that, in the second of the two installations already at work, the sulphur compounds on the inlet have varied from 62·86 to 16·01 grains per 100 cubic feet; while on the outlet the quantity has varied only from 8·71 to 5·82 grains. This conveys an impression of reliability, which has never before been connected with any system of purification from sulphur compounds. Again, in the case of the first installation, which was constructed to deal with 2 million cubic feet a day, it has been found during a period of over eighteen months that the average on the inlet has been 31·94 grains, while on the outlet it has been 8·45 grains. One may, therefore, safely come to the conclusion that it is a most efficient process—far in advance of lime purification. Its efficiency would be greatly marred were it to have any appreciable effect on the quality of the gas. Fortunately this is not the case, for an analysis of the gas before and after treatment shows clearly that the gas is affected but slightly, and in any case is not deteriorated in quality.

In the matter of working costs the figures have already been given. From these it can be seen that "fuel" accounts for not far short of half the total expenditure. It may be assumed, from the remarks Mr. Carpenter made in the discussion, that this figure will be considerably reduced in the future owing to better recuperation. Considering that for every million cubic feet of gas purified about 15 cwt. of coke only are used, the process cannot be considered as extravagant even on the present basis of fuel consumption. But in any case if money is to be expended on a new process, better far that it should be on "coke" than on any other material, for it is a bye-product that appreciates in price by every ton that is taken off the market. Gas engineers will, therefore, look upon this item of expenditnre with a certain amount of equanimity. The charge for labour is small enough to be disregarded.

The third item—interest, sinking fund, and repairs—leaves a good deal to the imagination, and one dare not hazard any estimate as to the respective expenditure on each of the three headings comprising this item. Given data as to the interest and sinking fund, one could then arrive at an approximate estimate of the capital outlay on this type of plant, but with repairs included the attempt is useless. The cost of the plant, however, seems to be rather heavy. But, on the other hand, it must not be forgotten that under the heading of "purification charges" in all published figures, the cost consists merely of "material and wages," and does not include "interest, depreciation, and wear and tear." Were these included, this figure, instead of ranging from 0·10d. per 1000 cubic feet to 1·00d., would be higher by about 0·50d. per 1000 cubic feet. Therefore, if we consider the new process from this aspect, neither the working expenses outlay nor the charge for interest, sinking fund, and wear and tear seems unreasonably heavy. In any case we trust that more information will be forthcoming at any early date.

RETORT-HOUSE IMPROVEMENTS.

The commencement of a new year is usually the signal for the preparation of plans for the summer reconstruction work. Most

* See "JOURNAL," Vol. CXXIII., p. 30.

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engineers at this season of the year have come to the conclusion, as the result either of the past half-year's figures or of mid-winter difficulties, that certain improvements must be made in their retort-house plant. We are always hearing of some other engineer who is doing better than ourselves in some particular point, and this sort of rivalry is all to the good. No one man holds the record for everything that counts in retort-house results. We can, therefore, safely conclude that there are several ways in which our own plant and methods can be improved. During the next few months the writer intends to refer to many of the points in retort-house working which are likely to be under discussion when the summer repairs are being considered. He cannot hope to be original in his suggestions, but he trusts that, in a humble way, he can be of assistance in at least awakening inquiry.

Disadvantages of Single Ascension-Pipes.

In this connection it is noteworthy that the Birmingham Gas Department Magazine refers to the disadvantages of using one ascension-pipe on through retorts. Their remarks, which are *à propos* of naphthalene formation, are worthy of reproduction, and are as follows: "The formation of such large quantities of naphthalene is probably due to the modern system of carbonization in horizontal retorts. About 80 per cent. of the coal gas is made in retorts measuring 24 by 16 inches, ⏢-section, by 20 feet long, each fitted with only one ascension-pipe, 8 inches diameter. In consequence, the gas produced is in contact with the hot coke and the walls of the retort for a longer period than was the case in previous installations, where two ascension-pipes were used per retort, and where the temperatures of the retorts were from 100° to 200° Fahr. lower. This increase in temperature and time contact has the effect of 'cracking' certain of the hydrocarbons contained in the gas, with the consequent production of naphthalene, which afterwards deposits on cooling. It may be mentioned that no naphthalene trouble was ever experienced at the above works before the starting-up of the new retort ranges."

Formation of Sulphur Compounds.

This is very much to the point; and the above remarks on the disadvantages of single ascension-pipes as regards the formation of naphthalene are equally applicable in the matter of the formation of sulphur compounds. This would be expected on theoretical grounds. We also know it to be the case in practice; for in the discussion on Mr. Cleasby's paper [see "Journal," Vol. CXVI., p. 460] to the Southern Association, November, 1911, three such experienced carbonizers as Messrs. Bell, Morrison, and J. W. Helps gave indisputable evidence to this effect. Mr. Bell stated that at Derby he had found that gas made in retorts fitted with single ascension-pipes contained a higher quantity of sulphur compounds by no less than 20 grains per 100 cubic feet than that made in retorts worked under exactly similar conditions, but fitted with double ascension-pipes. Further it is probable—although direct evidence is not forthcoming in this case—that the same conditions which increase the formation of naphthalene and sulphur do also reduce the percentage of hydrocarbons, tar, and ammonia in the gas. Again, where it is desired to work with filled retorts, it is necessary to use two ascension-pipes, owing to the coal frequently blocking the retort at some point. This has been commented on by various engineers, and is a point that cannot be disputed.

Taking everything into consideration, the using of single ascension-pipes cannot be advised, though the writer is well aware that there is a substantial saving in first cost in providing single pipes, and there is, further, some saving in the labour of pipe-jumping.

MIDLAND JUNIOR GAS ASSOCIATION.

Inspection of the Woodall-Duckham Retorts at Windsor Street.

On Saturday afternoon, a visit was paid by a number—not a very great number, unfortunately—of members of the Association to the Windsor Street Gas-Works of the Birmingham Corporation, for the purpose of inspecting the large installation of Woodall-Duckham continuous vertical retorts which has been in operation there for the past fifteen months or so. The party (which was headed by the President, Mr. W. H. Johns, of Malvern) were met on arrival by the Engineer of the works (Mr. John Foster), Mr. Tomlinson, and several assistants, who conducted them round, and fully explained everything connected with the plant. In addition, a paper on the subject was subsequently read by Mr. C. F. Tooby, who was formerly at the works, but has now been promoted to another position at Saltley. The paper was followed by some further interesting information from Mr. Foster, who bore testimony to the satisfaction which the installation has given.

The first part of the plant inspected was the 100 K.W. turbo-alternator, in duplicate, which supplies the whole of the current required; but on the way to it, through the exhauster-house, considerable attention was attracted to one particular piece of apparatus. This was a British Thomson-Houston turbo-exhauster, of which we hope to be able to give more particulars on an early occasion. Mr. Foster explained that he was confronted some time ago with the facts that further exhausting power was needed, and that there was not room in the house for another machine of the usual gas-works pattern of the size required. Under these circumstances, he decided to put in a turbo-exhauster of 500,000 cubic feet per hour capacity. In five months' working, the apparatus has quite fulfilled his anticipations; and he has run it up to 540,000 cubic feet. It works at a speed of 3600 revolutions per minute, with a total pressure of 58 inches—that is, 40 inches on the outlet, and 18 inches (vacuum) on the inlet. The ground space occupied is only some 8 feet by 6 feet. The steam consumption is less, the oil consumption practically *nil*, and owing to the absence of reciprocating parts the wear and tear is slight. It is also noiseless. The machine is said to be the first of its kind to be used for exhausting in gas-works in England, though one was put in at Mariendorf about two years ago.

The coal unloading and handling arrangements were seen; and here it was stated that no difficulty at all is experienced in carbonizing cannel with the coal, though, of course, only a very small quantity is used—about 1 per cent.—for illuminating power requirements under existing conditions of testing. Then, in one of the two electric lifts, the members were taken to the top of the vertical retorts, which are arranged in 22 beds of four, of a total capacity of 5 million cubic feet per day. It was pointed out that the retort-house governor, though it worked very well, has been thrown out of action, because it is found possible, by governing in the horizontal house, to get a steady pull without it, owing to the difference in level of the vertical and horizontal plant. One of the verticals was out of action for scurfing; and the visitors were able to see for themselves the excellent state in which it was, after more than twelve months' operation. The comfortable working conditions of the installation were generally remarked upon.

The coke is a very important part of the process; for, as Mr. Foster stated, it was largely considerations in this respect which made it so desirable to adopt the continuous vertical system at Windsor Street. The coke is dropped from the extractor into buggies holding about a ton, and these, suspended from a runway, are drawn by horses to the yard, where they are attached to a steam crane which takes them to the hopper of the screening plant. There the coke is screened into different sizes and loaded into trucks or bags, or the contents of the buggies can be tipped straight on to the coke heap. Considerations of space made the adoption of this system desirable; and by it the coke is not knocked about. It is beautiful coke—soft and friable—for household purposes, the demand for which forms the main portion of the market as far as the Windsor Street works are concerned. For water-gas making, too, continuous vertical retort coke is found eminently suitable. With fairly good dry horizontal coke, about 33 lbs. per 1000 cubic feet is needed; while with the vertical coke some 7 lbs. less suffices. It is, again, very useful, mixed with furnace coke, for blast-furnaces—being so easily lit up. For melting furnaces, however, where the pots are heavy, the coke is somewhat too porous to prove altogether satisfactory.

A point about the Windsor Street works is the extraordinarily even consumption of gas. They start on practically a million cubic feet output per hour at nine in the morning, and this goes on right through the day, with a maximum of about a million-and-a-half, though there is, of course, a drop in the dinner hour. A new 150,000 cubic feet per hour rotary meter for water gas has lately been installed; and it is found to be very accurate in working.

To return for a moment to the vertical installation, it may be remarked that the retort-house in which it is placed (along with horizontals) lent itself very well to the new system. With horizontals it has done as much as 10½ million cubic feet a day; whereas if it is all transformed to the Woodall-Duckham plant, it will be possible to turn out at least 20 million feet a day, and still leave room for storing from 6000 to 8000 tons of coal.

The Working of the Plant Described.

After the inspection of the plant, the members assembled in Mr. Foster's office on the works, and here Mr. C. F. Tooby read a paper entitled "Notes on the Working of the Woodall-Duckham Installation of Vertical Retorts at Windsor Street." This, and the discussion arising out of it, will be found on p. 150.

A Vote of Thanks for the Visit.

The President proposed a hearty vote of thanks to the Gas Committee of the Birmingham Corporation for their kindness in allowing the members of the Association to visit the installation, and also to Mr. Foster, Mr. Tomlinson, and the assistants, for the way in which they had shown the visitors round and explained everything to them.

The Hon. Secretary (Mr. W. J. Pickering, of Birmingham) seconded the vote, which was cordially passed, and acknowledged by Mr. Foster.

The Annual Dinner.

The President, before the members separated, said he would like to point out to them that the annual dinner of the Association would take place next month at the Great Western Hotel. He hoped there would be a large number present—especially as Mr. F. J. Bywater (who was the first President of the Association) was coming from London to give them an address.

Encouraging Benzol in Germany.—In connection with the development of the benzol movement in Germany, the Verein Deutscher Maschinen-Ingenieure, of Berlin, is offering a prize of £100 for the best paper submitted in competition on the subject of the "Recovery and Utilization of the Bye-Products of Coal and Lignite."

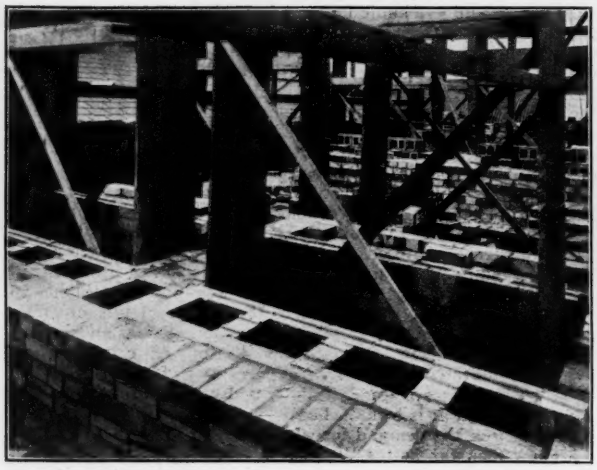
NOTES ON THE WORKING OF THE WOODALL-DUCKHAM INSTALLATION OF VERTICAL RETORTS AT WINDSOR STREET, BIRMINGHAM.

By CHARLES F. TOOBY, of Birmingham.

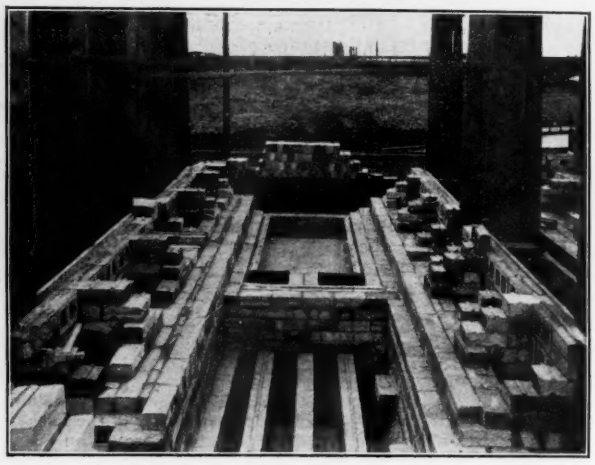
[A Paper read before the Midland Junior Gas Association, Jan. 17.]

The plant is of a capacity of 5 million cubic feet per diem, and consists of 22 beds, each containing four retorts, together with coal emptying, crushing, conveying, and elevating plant, and a suspended runway system for the removal of the coke from the retort-house.

The coke-extractors are driven either by a 10 H.P. motor or a 12 H.P. gas-engine. Actual tests show that less than 5 B.H.P. is required for this purpose. Two electric lifts are provided for elevating the coal in case of a breakdown of the elevators, or for



Photograph taken during Construction of Retorts and Heating-Flues.



Showing Position of Producer and Regenerator, &c.

The coal required is taken into the retort-house in railway-waggons on a viaduct, where it is emptied into the crusher-hopper by a waggon tippler, driven by a 5 H.P. motor. Four clamps, each actuated by a hydraulic ram, hold the waggon securely to the rails; and the tippler is rotated until the waggon is almost inverted. From the hopper, the coal is fed over a jigging screen (which bye-passes the small coal) into the crusher, which is driven by a 45 H.P. motor. A safety coupling is fitted in the first motion shaft. From the crusher to the shoot feeding into the gravity bucket elevators, the coal is conveyed by a belt conveyor driven by a 14 H.P. motor. The two gravity bucket elevators, each driven by a 20 H.P. motor, supply the coal to two tipping-tray conveyors driven by 10 H.P. motors, which deliver to the storage hoppers. Either coal or coke (for firing the producers) is dealt with by the elevators and tipping-tray conveyors. The plant is of a capacity of 100 tons an hour.

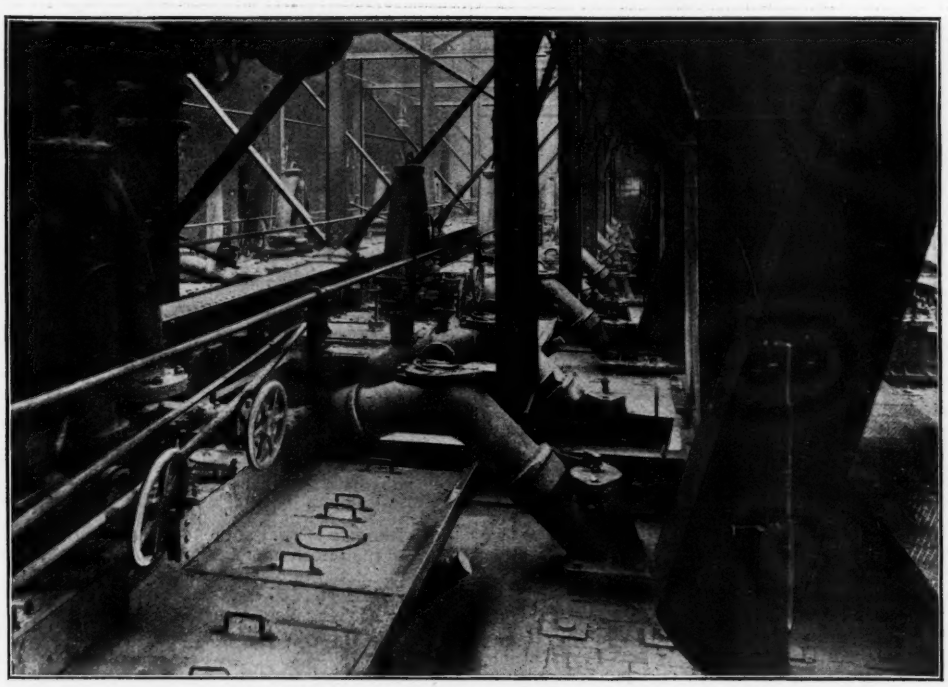
passenger use. The whole of the current required is supplied by a 100 K.W. turbo-alternator (in duplicate), developing three-phase alternating current, 440 volt, 50 cycles. A Tirrill regulator is employed for voltage regulation. All motors employed are of the slip-ring type.

The accompanying photographs show the Woodall-Duckham settings in course of construction and completed.

THE RETORTS.

The retorts are 25 feet long and 3 ft. 10½ in. by 8 inches at the top, tapering to 5 ft. 3 in. by 1 ft. 8 in. at bottom. The taper is mostly in the top 10 feet, as it is there that sticking of the charge is most likely to occur. The sides are built of special panelled-out

THE COAL BUNKER STAGE, SHOWING TIPPING-TRAY CONVEYOR AND RETORT-HOUSE GOVERNOR.



SHOWING A PORTION OF THE CHARGING STAGE.

tiles, which combine mechanical strength with a high rate of heat conductivity. About 9 feet of the top portion of the retort, commencing from the heating burners, is constructed of Silco material, the remainder of Stourbridge.

The Producer.

There is one producer to each bed. It has a grate area of approximately 22 square feet. The gas off-takes are so arranged that the depth of active fuel is constant (about 5 ft. 6 in.), which, of course, tends greatly to evenness in composition of the producer gas.

The Regenerator.

The regenerator is of the baffle-brick type, with partition walls constructed of panelled-out tiles.

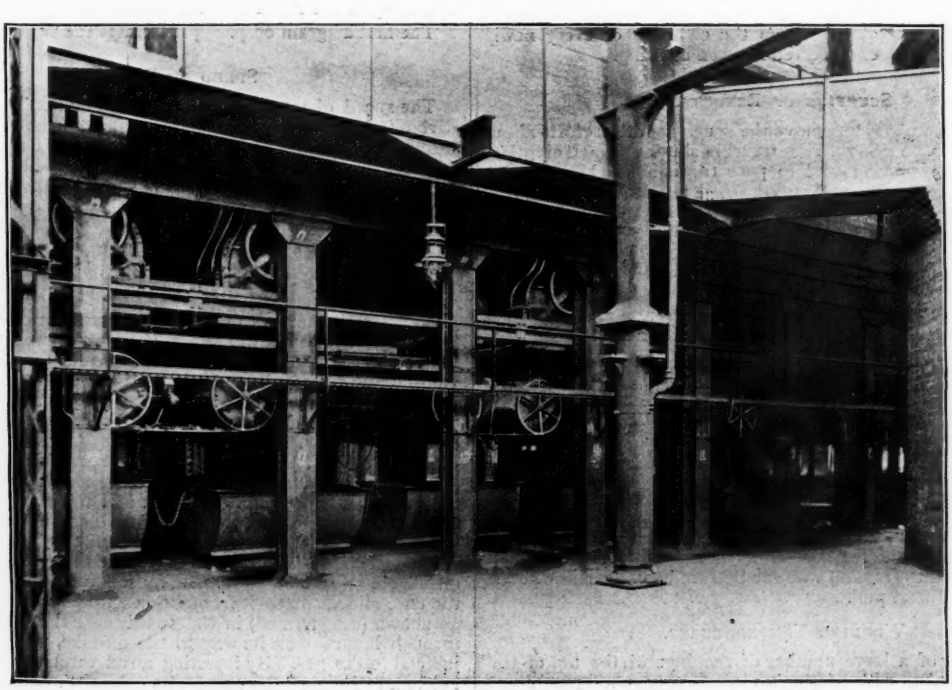
Heating Arrangements.

The primary air enters on the producer side of each setting, through eight tubes built into, and forming part of, the side-walls of the retorts, passes to the other side of the setting, and then through flues in close proximity to the waste-gas flues leading from the outlet of the regenerator to the main flue, and is ultimately saturated with water vapour by passing over water in three troughs situated in flues immediately under the producer, before reaching the fire. The economy of pre-heating the primary air in this manner is obvious, while the moisture assists largely in preventing the formation of hard clinker.

There are two gas exit ports from the producer; and from these the gas passes to horizontal flues, and then through vertical uptakes, to horizontal flues near the top of the retorts. Thence it passes to the vertical retort heating flues, where it meets the secondary air. The latter, after leaving the regenerator, enters the vertical heating flues from horizontal flues immediately above, and similar to, those for producer gas. There are eight vertical combustion chambers (or heating flues) to each retort—four on each side.

The products of combustion pass into horizontal collecting flues near the bottom of the retorts, and then through four vertical uptakes to points near the top of the setting, where they enter the regenerator. Entrance to the main flue is controlled by two main dampers to each bed, and further adjustment of the heating is obtained through four check dampers to each retort.

The heating of the outside of the retort walls may be readily observed through sight-holes on the top of the settings.



SHOWING THE COKE DISCHARGE AND COKE REMOVAL ARRANGEMENTS.

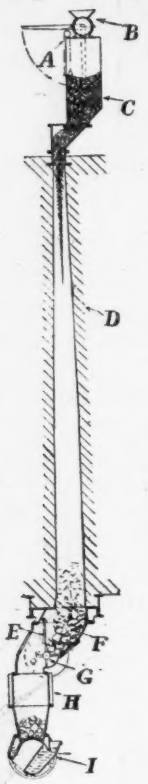
Drying-out the Beds and Getting-up Heats.

The principles governing this process are essentially the same as apply in the case of other regenerative settings. The drying-out fire should be small, and liberally supplied with air to ensure complete direct combustion of the fuel, and to avoid the passage of any unconsumed producer gas into the setting. The plugs should be removed from the various parts of the setting, to allow easy escape of steam from the brickwork. The fire should be gradually increased, and setting plugs inserted. When the producer arch shows a good red colour, it is usual to have 3 or 4 feet depth of fuel, and to restrict the air supply so that producer gas is formed, which is burnt by secondary air admitted through a temporary porthole just above the fuel bed. This mode of gaseous firing is continued until the brickwork around the producer gas burners (top portion of vertical heating flues) shows a good red colour. The primary and secondary air (from the regenerator) slides are then adjusted, the temporary secondary air port are blocked up, and the depth of fuel is gradually increased.

Care must be taken to avoid overheating of the producer crown during the admission of secondary air over the fuel bed.

General Working.

The illustration shows plainly the coal-feed and coke-extracting arrangements. The producers are fed with cold coke every three hours, and clinkered every 72 hours. A is the indicator; and B, the feed-roll, actuated by hand every two to three hours. C is the auxiliary hopper, containing a two to three hours supply of coal. The charge in the retort D takes six to seven hours to travel from the top to the bottom. E are layers in the extractor box F, in which also work the rollers G. The capacity of H is from two to three hours supply. The water-sealed discharger I is opened every two to three hours.



To put a retort into action (having the heats in good condition, the extractor-door sealed, &c.), it is first filled with coke to within about 3 feet of the top. The extractor should be in gear during the filling, to prevent packing of the coke on the extractor. The coke-filling door is then closed, and the remainder of the retort and auxiliary coal hopper charged with coal. When the evolved gases show at the plug-holes at the top of the retort and at the off-take, the plugs are inserted and the gas-valve opened. At starting, it is usual to have the extractor working at a speed somewhat slower than the normal, or to work it at the normal speed and throw it out of gear occasionally for a short time, until the newly-made coke appears at the extractor—usually after about 16 hours. This reduction of the extractor speed is necessary because the coke used for filling is inclined to travel over the extractor too quickly, with consequent excessive coal feed. For the same reason, it is usual to remove a slightly smaller amount of coke from the chamber of every newly charged retort when drawing.

Scurfing of Retorts.

It is found necessary to remove the scurf from the retorts abou every five weeks. To do this, the retort is shut-down and emptied and a current of air allowed to pass through it. Most of the scurf falls away readily, and only a small portion at the top has to be removed with bars. The greater part of the scurf forms in the upper 10 feet. During scurfing, the temperature of the combustion chambers is maintained at about 1700° to 1750° Fahr.

The following table shows the average condition of draught in different parts of the settings. All readings are in tenths of an inch water-gauge.

Stack.	Over Main Dampers.	Bottom of Heating Flues.	Top of Heating Flues.	Producer Gas Feed Flues to Burners.	Second Air Feed Flues to Burners.	Under Fire-Bars.
− 9	− 5½	− 3½	− 2	− 1¼	− 1¼	− 1¼

From the readings for the heating flues, it will be seen that furnace gases will not be drawn into the retorts unless there is considerable vacuum on the retorts.

With level gauge at the gas off-takes and the retorts working normally, the gauge readings at the bottom castings show about 1·10th to 1¼·10ths of pull.

Working Temperatures.

The average of a large number of readings at the top of the heating flues, taken with Watkin's recorders, gave a temperature of 2130° Fahr., and of the bottoms of these flues (at the check dampers) 1620° Fahr. (by Fèry spiral).

With regard to the temperature of the charge, it would appear that the highest average temperature prevails in a zone about 8 or 10 feet from the top.

Shutting-down and Re-starting on Sunday.

The following is an account of the experience at Windsor Street.

First Method.—The last charge was put into the auxiliary feed hopper at 3 a.m., and the extractor kept working until the top of the charge was lowered to about 2 feet below the top of the retort. The extractors were then stopped, and the charge allowed to carbonize completely. The gas off-take valve was checked as the make of gas fell off. When the gas became too poor to collect, the gas-valve was closed, and the plugs removed from the top of the retort and off-take. Dampers and air-slides were then reduced. The charge of hot coke remained in the retort until starting-up. To start-up the retort, the extractor was pulled round by hand until the top of the charge fell to a point just below the bottom edge of the division plate. The extractor was then put in gear, coal admitted, plugs inserted, and the gas-valve opened. This method was abandoned for the following reasons:

1.—The shutting-down required several hours to accomplish, because each of the 88 retorts had to be dealt with separately, both as regards the manipulation of the gas-valves and plugs and the lowering of the charge to the required position.

2.—Absence of coal in the auxiliary hopper and top portion of the retort, and presence of hot coke in the retort, caused the top retort ironwork and the feed hoppers to become very hot; and this, together with smoke from the plug holes, made the charging and coal bunker stages almost unbearable. The high heating of the top brickwork was harmful.

3.—The charges subsided a little while standing, and the scurf on the top empty portion of the retort bulged and became detached, and gave great trouble at re-starting by holding-up the charge.

Second Method.—To overcome these difficulties, the following method was devised and put into operation on the whole plant, when it was required to shut-down and re-start. The coal "core" in the retort is increased either by increasing the speed of the extractor engine for a few hours before the end of the last shift, or by reducing the heats for the last few hours, keeping the extractors at normal speed. In either case the temperature at the top of the heating flues should be about 1750° to 1800° Fahr. at the end of the last shift. The coal-feed hopper (in direct communication with the charge) should be left half full, and the engine driving the extractors stopped at 5.45 a.m. No extractors, plugs, or gas-valves are touched during the day. The exhauster is governed to give a slight pressure on the retorts. At about 5 p.m., the exhauster is stopped; and the small amount of gas being evolved is allowed to blow off from the foul main through a safety seal. To start-up, the extractor engine is put to work (thus starting all the extractors), the blow-off is closed, and the exhauster started. Dampers and air-slides are then adjusted. It is possible to start the extractors at full working speed immediately, and to maintain full speed right through. It is a matter of accommodating the rate of temperature increase to the rate of travel of the core. During the shut-down period, all the top ironwork remains cool, and there is no smoke.

The first diagram on p. 153 illustrates the two methods.

Speed of Working.

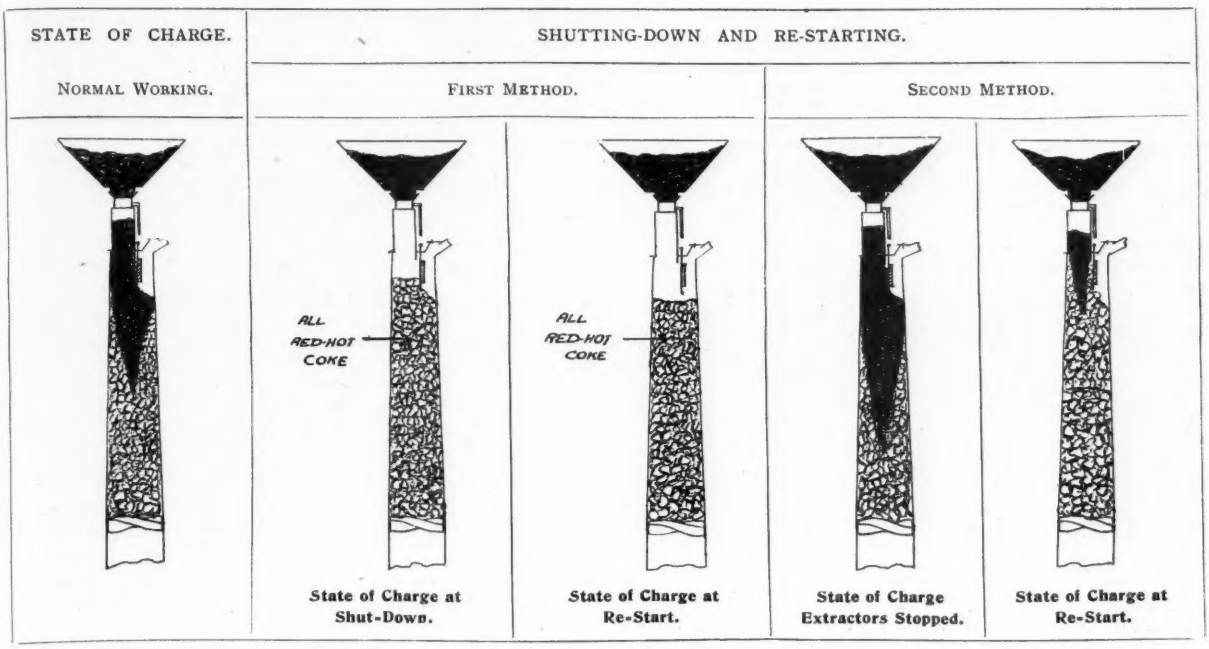
The speed of travel of the charge should be such that the uncarbonized core extends as far as possible, consistent with thorough carbonization, down the charge. The rate of heat transfer from the heating flues to the charge will then be greatest. It is an easy matter to regulate the speed of the extractors; and the extractor gearing has given no trouble whatever.

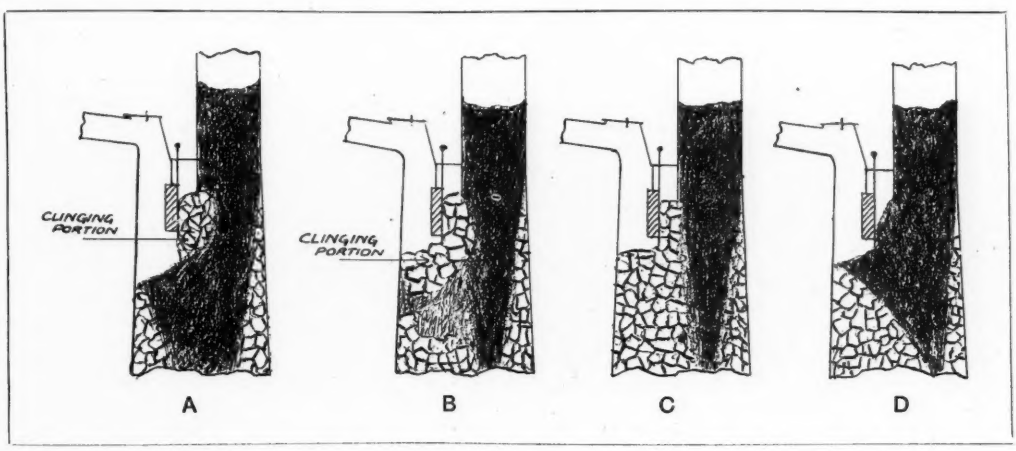
Effect of the Division Plate.

The division plate is inserted to create a heated free space in which the low-temperature products shall be broken-down. Combustion in the heating flues takes place at a distance of some 3 feet from the top of the retort, so that it seems improbable that temperatures sufficiently high to effect this "cracking" can prevail—at any rate, in the top 3 feet of the free space. Further, the present arrangement of the plate appears to have a detrimental effect on the mechanical working of the charge, as well as on the quality of the gas.

In practice, it is found the charge has a tendency to cling—see A and B, second diagram. When this takes place, the obstruction not only hinders the proper travel of the top portion of the charge, but, in addition, the clinging mass becomes more carbonized than it should be, having regard to its being only at the commencement of its travel through the retort. The mass when dislodged, or allowed to remain, must have a tendency to distort the core and displace it from its central position in the charge, as shown (exaggerated) in C. In this case the gas has to travel through hot coke on its way to the off-take, which must be prejudicial to the gas. By inserting a rod through the off-take plug hole, and "feeling" the charge, its coky nature can be frequently observed. Further, in many cases, rodding at the off-take will cause an immediate feed of coal into the retort.

Experiments were carried out by inserting rods vertically into





the charge at different points, allowing them to take the temperature of the charge, withdrawing them quickly, and measuring the red-hot portion. In some cases, the core, instead of being quite central, occupied a position as shown roughly at D. Possibly a separate and separately heated free space would improve the working. The average of a number of temperature readings taken with a thermometer placed in the gas off-take near the retort gave 258° C. when the free space was 2 ft. 6 in. long, and 312° C. when it was 3 feet long.

Pitch has been a trouble with most modern carbonizing methods. It is undoubtedly formed with Woodall-Duckham retorts; but the arrangement of plant and system of tar circulation are such that it is deposited in the tar-pots, is easily removed, and gives no trouble in any other portion of the plant. One man per shift on two shifts only a day, deals with its removal. Five men on the charging stage, four firemen, and four men for coke removal, per shift, are employed on the plant. After more than a year's working, the retorts are in excellent condition.

Working Results from a Medium Class Coal.

Make per Ton. C. Ft.	I. P.		C. V. B.Th.U. Net.	Tar. Gallons per Ton.	Liquor. Gallons 10 oz per Ton.	Fuel. per Cent	C. Ft. of Gas per Sq. Ft. of Retort per 24 Hrs.
	No. 1 London Argand.	No. 2 Metrop. Argand,					
12,166	13·99	15·82	504	13·4	35·0	11·03	212

Graphic records of the calorific value of the gas showed very little variation in quality over long periods.

Gas Analysis.

CO_2.	O_2.	HC.	CO	CH_4.	H_2.	N_2.	Specific Gravity.
2·59	0·49	2·97	10·02	26·8	47·8	7·5	·466

Distillations of Tar.

—	No. 1. Moderate Heats.	No. 2. Higher Heats.
	Per Cent.	Per Cent.
Up to 100° C.	1·5	0·6
100—130	1·0	1·8
130—170	2·2	0·4
170—230	11·4	16·2
230—270	17·5	14·2
270—330	18·0	15 7
330—350	12·4	6·9
350—370	12·0	9·0
Pitch	24·0	35·2

CONCLUSION.

Continuous carbonization on a large scale has proved itself to be thoroughly practicable and efficient. The system offers a wide field for experimental research. Close investigation of what takes place in the retort, physically and chemically, would undoubtedly prove invaluable. With the highest external temperatures near the top of the retort, is all the coal subjected to as thorough a distillation as it might be? Or would higher bottom heats be any better?

DISCUSSION.

The PRESIDENT (Mr. W. H. Johns, of Malvern) said that Mr. Tooby was in a good position to answer any question regarding the working of the plant; but they would also like to have the views of the Engineer, Mr. Foster, on vertical retorts. The installation at Windsor Street was one of the largest that had been put up in this country on the Woodall-Duckham system, if not on any system of continuous carbonization; and so they would be glad of any additional information Mr. Foster might give them. Personally, he did not know that he had a great deal to say on the subject before them, because he had already said so much about the various systems of carbonization to be seen in Birmingham. Two months ago, the Association visited Saltley, and saw the Koppers chamber ovens; and this was followed by a visit to the Dessau plant at Nechells, and the coal-testing plant, with a paper. Now,

in the Woodall-Duckham, they had seen still another system of modern carbonizing, to which he would like to give his praise. The information which had been given to the Association would no doubt be found very valuable to them all later on, even if not greatly discussable just now. It would be specially useful to anyone when faced with the question of installing some new system in his own works. There were, of course, some special matters to consider in connection both with continuous and intermittent vertical retort working; and he was not going to say which he thought the better system. This they must judge for themselves. Probably they would be in a better position to discuss the whole matter after they had been to Leicester and seen the Glover-West installation there. In connection with papers of the character of the one just now before them—when a subject was dealt with by giving a description of a plant, with no comparative figures of cost (perhaps it was advisable that such figures should not be given)—all they could do was to criticize the general arrangement of the installation. What they had seen that afternoon was so satisfactory in all its details that it allowed very little room for any adverse criticism. One point that occurred to him—which no doubt Mr. Foster had foreseen—was the difficulty of conveying coal to the overhead hoppers, in case of a breakdown of the gravity bucket conveyor. One could imagine it being a difficult job to deal with a fractured link in a conveyor of this description; and if much delay occurred, there would be trouble in regard to gas making—unless, as had been done in this case, sufficient storage capacity had been arranged for. At Windsor Street, he understood, other means were also available for getting coal up to the storage hoppers. As to carbonizing results, he had read lately of a make of 13,600 cubic feet per ton at a certain works; and no doubt they could all reach this figure, if they wanted to. No candle power, however, was given in that case; and it was not invariably the best policy to go for the highest possible make per ton. They were all aware that in some instances it was advisable to get as much gas as they could out of the coal, and then enrich with benzol; in other works arrangements for doing this were not in existence, and probably the cheaper plan in the long run was not to aim at such a high make, and to repay oneself with higher returns from residuals. The returns of tar and 10-oz. liquor were very good in the Birmingham installation.

Mr. S. A. Wilkner (Messrs. Hardman, Birmingham) remarked that, though he was not engaged in gas making, the paper was one in which he had been much interested. He believed that vertical retort tar was lower in pitch content; and yet there were pitch troubles experienced. Then, again, he found that pitch which was taken out of the hydraulic mains or tar-pots was very high in volatile matter, but exceptionally high in ash. There was from 3 to 8 per cent., whereas with ordinary coal tar pitch there was about 0·1 per cent. Such a high percentage of ash in the pitch would make it unsaleable for many purposes. As to the table in the paper relating to distillations of tar, the pitch figures were very low indeed. In fact, he had never met with tar having a 35 per cent. pitch content. They found about 315° gave a good marketable pitch. He would be glad to know the specific gravity of the tar, and also the free carbon content, which was a very important point.

Mr. F. Rudge (Leicester) remarked that one point about which he was not sure was the pressure on the retort. He did not understand how, if there was a level gauge at the top, there should be 1½-10ths pull at the bottom.

Mr. H. E. Stone (Birmingham), in proposing a hearty vote of thanks to the author, said the members had had a very instructive afternoon; and they had all been struck with the comfortable conditions of working with the Woodall-Duckham system—the absence of any smoke and flame, and the smoothness with which everything seemed to be running. Taking the pitch figures as comparative, he noticed that an increase in temperature sent up the percentage of pitch by about 10. From what he knew about pitch troubles in vertical carbonization, it seemed to him that the temperature of carbonization was going to be restricted by them. What he meant was that if they went above a certain temperature, they were going to be troubled with pitch; and consequently the temperature of carbonization was somewhat limited. It was admitted that on the illuminating power basis verticals did not come up to horizontals; and one of the reasons might be that they did not get the same heats of carbonization. Mr. Tooby did not say whether any trouble had been experienced with ammonium chloride in the tar. If he had any figures of the ammonium chloride in these particular tars, it would be useful to have them. Great care was necessary in starting-up and shutting-down vertical retort installations; and the method described in the paper was an excellent and simple one.

Mr. R. J. Rogers (Birmingham), who seconded the vote, remarked that, as a non-manufacturing man in the industry, he had been greatly impressed with the difference between the old method of carbonization and the new, both of which they had seen in operation that afternoon. The scheme of combined visits and papers, when it could be carried out, was a very good one.

The vote having been put to the meeting, and carried with acclamation,

Mr. Tooby proceeded to reply to the points that had been raised by the different speakers. He said that the time which the charge took to travel from the top to the bottom of the retort was nearer twelve hours than six or seven hours. As to what the President had drawn attention to with regard to conveyors, there were, of course, in the Birmingham installation two conveyors provided, and each could be used for elevating either coal or coke. This appeared to him sufficient; but, in addition, there were lifts by which material could be taken up. The high percentage of ash in the pitch he thought was due to dust carried over from the retorts. The coke was continually on the move in the retorts; and there must be a considerable amount of dust carried over and deposited in the pitch traps. As to the tar tests, he had no such figures as were asked for in reference to the specific gravity and free carbon. The level gauge at the top, and 1½-10ths pull at the bottom of the retort was, he believed, due to the difference in levels. The tars referred to in the paper were made in the tests they took at Luton on the Woodall-Duckham installation there. There had been no trouble at all with ammonium chloride; and he had no figures as to the ammonium chloride content of the tar. Mr. Stone had spoken about pitch trouble restricting the temperature of carbonization. He (the speaker) thought the passage of the gas through the hot coke, due to the division plate, had a lot to do with the formation of pitch. If this could be re-arranged, it seemed to him the difficulty would be overcome. In regard to free space, in the Woodall-Duckham retort, with a free space 3 feet long, this was equal to 0·6 cubic foot per ton of coal carbonized per day. With horizontal retorts, 25 in. by 15¼ in. by 20 ft., and 10 cwt. charges, it might be reckoned at 16 cubic feet. It appeared to him that the free space in the Woodall-Duckham retort, as at present arranged, was not of much use. It was so small. The naphthalene figure at the outlet of the condenser was about 5 to 6 grains; and at the inlet of the purifiers, 2·8 grains. The yield of gas, which was 212 cubic feet per square foot of retort per 24 hours, was high compared with horizontals, with which 150 or 160 feet was a good figure.

Mr. John Foster (Engineer of the Windsor Street Works) said that in the first place he would like to thank Mr. Tooby for the arrangement of shutting-down on Sunday. This process was a trouble with the continuous system; for with such plant it was not supposed that one would shut-down in working, and naturally if one did do so there was going to be some difficulty in re-starting. When they commenced working the installation, there was this trouble; and it was mainly due to Mr. Tooby (although no doubt other juniors had a hand in it) that it was now possible to shut-down in summer time without very much difficulty. It was still a trouble, but very much less so than at the beginning. It was not now so costly to shut-down that they could not do it. They had a rule in Birmingham that from the beginning of May until September, carbonizing plant must be shut-down on Sunday; and when May arrived, he could not see how they were going to do it economically with this installation. However, it was only about the second Sunday in May that they tried their first experiment with the new arrangement; and they continued to work in this way right up to the winter. Probably many of those present would like to know the reason why the Woodall-Duckham system was put down at Windsor Street, as compared with the Dessau system at Nechells, and Koppers ovens at Saltley. In a place like Birmingham, it was necessary to make one's coat according to one's means. Coke was one of their first considerations; and it was a well-known fact that with continuous vertical retorts the coke obtained was quite different from what it was with other systems. It was much softer and more friable than it was from horizontal retorts or coke-ovens; and as the Windsor Street Gas-Works were in the centre of the city, practically 75 per cent. of the consumption of coke was for household purposes. It was, of course, necessary that they should in the first place endeavour to produce a coke that was suitable for the bulk of their customers; and this was one of the great points with him in deciding upon the Woodall-Duckham system. They obtained tenders for various systems of horizontal working, as well as Dessau and Glover-West verticals. It would have been no use going in for coke-ovens there, because the class of coke they produced was not required. In connection with these tenders, everything was taken into consideration—the cost of the plant, and the various advantages gained by the different methods of carbonization; and he found that, taking the capital cost into account, the arrangement of the plant to work in with the existing system, together with this main factor of coke supply, the Woodall-Duckham installation would be most advantageous. Working out the capital cost, and the labour cost, and taking into consideration the naphthalene and sulphur compounds, retort-house lighting, the water used for quenching, &c., they found the Woodall-Duckham system would come out about 1s. per ton cheaper than the best system of horizontal working. It was slightly cheaper than the Dessau, and was also cheaper than the Glover-West. When they made a test with the plant, it more than fulfilled the estimated cost they had put down to it. The Committee were satisfied; and he was satisfied. The question of whether they should extend the installation resolved itself into a question of the coke. At present there seemed a good outlook for it. Continuous vertical retort coke was not suitable for use in melting with heavy pots, because the coke got burnt away before the metal was melted. In their water-gas plant, they found that when they used nothing but vertical retort coke they could work with 7 lbs. per 1000 feet less than with horizontal retort coke; and he was certainly of opinion that something might be accounted for by the fact that the coke was so friable that it allowed the steam to go right through the core of a piece of coke and pick up all the carbon. The percentage of CO_2 in the gas was less with this coke than with ordinary horizontal coke. This was why he thought his explana-

tion right. He did not want to say anything about working costs. The plant had, as he had already remarked, more than equalled the estimates that they had got out for it; and this showed that they had done the right thing. There was no doubt of the advantages of a system of this kind from a humanitarian point of view. His idea was that the staff would like them to go forward with the Woodall-Duckham system. Another consideration which came before him was the capacity of the retort-house they had at the present time. With horizontals, they made, he thought, up to 10½ million cubic feet a day; but thanks to Mr. Charles Hunt, who had allowed a good free space in the house for horizontal working, they were in the position that they could get four sections of Woodall-Duckham plant, of 5 million feet per day each, in the house, with 30 feet between each section, and still have room for storing between 6000 and 8000 tons of coal. It was a big consideration to be able to double the make of the retort-house; and he believed they could do more than this. With Dessau retorts they could just have got 20 millions, and also with Glover-West; but with the horizontal principle, they could not have obtained more than 15 million cubic feet. With reference to the remarks about trouble with elevators, it seemed to him that the difficulty was with what went into the crushers—tools, timber, &c. Now they had a boss with two ⅜-inch safety pins, so that if any such troublesome things got into the crushers the bolts were snapped, and everything was found out. It was generally agreed that with gravity-bucket conveyors there was less chance of breakdown than with any others—the speed was so slow. He had watched these things closely in connection with electrical plant; and he had satisfied himself that altogether there was less risk of breakdown with gravity buckets than with ordinary elevator plant. Then, again, they had provided two of these bucket elevators. They had but one belt, which it was thought would be sufficient for the time being, owing to the special circumstances of the case. The only question was with regard to the tipping tray conveyor on the top of the hoppers. There was only one of these, but the speed was very slow, and the wear and tear slight. It had been necessary to take out one link of the gravity-bucket conveyors, but not with the tipping-tray conveyor. There were 27 hours' storage of coal, and 48 hours' storage of coke; and if anything did go wrong, there were still the two lifts by which to get the material up. Some questions had been asked on the subject of pitch. There was no doubt that any system of vertical retorts would not give the same illuminating power and yield of gas as could now be obtained from the best horizontal systems. They knew in Birmingham that the horizontal retorts at Adderley Street and Swan Village would give a better yield of gas and illuminating power; but with the verticals there was a big increase of tar and liquor which compensated for this. Then there was no naphthalene; and he put the cost of this, when bad, at 3d. per ton of coal. In regard to pitch and ammonium chloride, there was no doubt that with vertical retorts they did not get quite the same heats. The highest temperature they worked at was about 2300° Fahr. in the flue; whereas with horizontals they got to about 2500°. The pitch was going to be affected by the outlet of the gas; and the trouble was going to be increased with an increase of speed. When they adopted the Woodall-Duckham system at Windsor Street, he would not have what he had seen before—that was, outlet pipes of 6 inches. He would not have less than 8 inches; and he thought the results had proved this to be the right thing—there had been so little pitch trouble. It was so slow that it dropped down into the tar-pots, and collected there. But if the size of the pipes was brought down, and the speed of the gas from the retorts was increased, this was going to bring over dust, and, he thought, pitch, and everything else. Mr. Tooby had mentioned the free space. At first, the free space was not put in at all; and then the inventors found that the tars were absolutely full of paraffins, and the illuminating power was nowhere. They, however, provided a loose plate, that could be raised or lowered according to requirements, and ascertained by tests that they obtained increasing benefits as they put the plate down into the retort. He thought he was safe in saying they found the greatest benefit, taking everything into consideration, was with the brick portion 1 ft. 9 in. deep as the free space. Division plates had been put in to increase this free space; but his own opinion was that the full value of the idea had been reached in the 1 ft. 9 in. depth, and that whatever was added to this was not going to be of any benefit.

Mr. Tooby said he quite agreed that if the free space was abolished altogether, bad results would be obtained; but it should be arranged so that the top part of the charge was not interfered with at all. He thought the free space should be increased; but it should be put in a different position, and differently heated.

Mr. Foster pointed out that, in the published particulars of Messrs. Dempster and Sons' system of continuous vertical retorts, there was at the top a kind of cast-iron shoot, which went down into the retort. It was smaller in diameter than the retort, and therefore allowed a free space for gas all round the iron portion. There were possibilities in this. If one could get an increase of free space without a material increase in temperature, two points would be gained. A gas would be obtained which would come off the coal at a slow rate, and therefore would not be subject to carrying the carbon forward; and one would not get the high temperature which caused cracking-up and produced naphthalene. When the plate was put down the retort too far, the claim of no naphthalene was lost. He might say that the throughput of their retorts was guaranteed at 5 tons per day; and they had averaged for the past week 5·3 tons. With certain modifications which it was proposed to make, they expected to get up to 5½ tons. In the tests they carried out at Luton, they got 6 tons through. This would bring down the capital cost on a per ton per day basis to that of horizontal retorts at the time they had the tenders in.

LOCALIZED COMBUSTION.

The following article by Mr. C. E. Lucke, Professor of Mechanical Engineering in the Columbia University, New York City, appeared in "Engineering News" (New York) on Dec. 11.

Localization of Combustion.

The flame cap will be steady in location when the velocity of gas mixture approaching it is equal to the rate of flame propagation. Mechanical construction to permit passages of suitably changing area may be in endless variety; but certain precautions are needed: (1) The tendency for a gas-jet from an orifice to resist sidewise expansion may prevent filling the passage unless forced to do so by baffles; (2) the tendency for free jets in a gaseous atmosphere is to entrain or diffuse at the edges, becoming so dilute as not to burn properly.

The simplest apparatus would perhaps be a narrow angle conical passage. In time such a tube would heat-back, and heating of the flowing mixture would increase its velocity and push away the flame surface. But this would be more than counteracted by the increase of flame-propagation rate due to the rise of mixture temperature and the accelerating effect of hot walls. In most cases, if the rate of supply is varied much there is a blow-off or a flash-back of the flame.

The simplest flame-spreader is a plate over a hole (fig. 1). This offers some operating difficulties, as both plate and hearth get very hot and unequally so. An easier construction is a solid cone with small ribs placed in a counterbore of the feed-hole (fig. 2). Another has a mushroom baffle with a square stem fitting in a round enlargement of the feed-hole (fig. 3). The dimensions shown gave good service with mixture pressures up to 3 inches of water. The most permanent form of moulded baffles is the refractory ball in a conical hole (fig. 4).

All such constructions only approximate uniform incandescence. However, any sort of porous screen wherein is the path of the escaping gases will get uniformly hot; and three types have been used: (1) A perforated plate of nonoxidizable alloy such as used in electric heaters, (2) a layer of granular refractory material, (3) a diaphragm of bonded granular material, the most satisfactory of which is alundum (artificial corundum or aluminium oxide).

In view of the importance of developing a maximum of heat energy in radiant form, and considering that loose granules or a porous diaphragm may serve the double purpose of radiating screen and combustion localizer, everything else may be abandoned for these, except, perhaps, in certain special cases. The work done has been largely concentrated on an effort to learn how these granular beds and bonded diaphragms should be handled to yield commercial apparatus. By reason of the simplicity of the loose bed, it has been consistently favoured over the bonded.

Any uniformed grained bed will act as a substantially perfect spreader for a mixture issuing from an orifice; but the quantitative effect of variations in size of grain, shape of bed, size and position of the orifice, &c., have all had to be determined by experiment.

One of the simplest arrangements is shown in fig. 5, where a nozzle projects into a bed of broken fire-brick. With coarse grains from ½ to ¾ inch in size, the mixture on ignition flashed instantly down through the bed, locating quite near the nozzle, as shown later by the more or less spherical lump that fused there. The same action took place as the size of grain was reduced to from 3-32nds to 1-16th inch, when the mixture burnt on top instead of flashing down through. In a few minutes the top layer became hot and then seemed to cool. On scraping away the top, it was seen that the combustion surface had receded. The combustion zone finally located where it was in the coarser material. To show that the reduced total gas flow and total heat generation due to stoppage of the nozzle by fine grain was not responsible for the difference in flame action at the start, the same series of results were obtained in a pyrimidal chamber (fig. 6), where the nozzle was made by a pair of hacksaw cuts in the pipe-cap; the flow being substantially the same for all different sizes of grain.

Once it was clear that size of grain made only a temporary difference in action, longer runs became desirable to find out the possible heating effect on the nozzles. Long runs with more refractory grain showed that some forms of feed orifices became heated so as to ignite the mixture in the feed-pipe, while some other forms permitted operation indefinitely.

At any time increase in pressure of the mixture supplied would have driven the combustion surface to a safe distance from the nozzle; but this was deemed an unwise expedient, since (1) all domestic apparatus must operate on low pressure, and (2) all industrial apparatus at some time would be operated at part capacity, which is equivalent to low-pressure operation.

Frequently the best working nozzle was really hotter than one which flashed-back quickly. It was clear that metal must be kept away from the feeding orifice proper. It was found that all feed-holes become incandescent at the fire end with a low gas

Fig. 1.

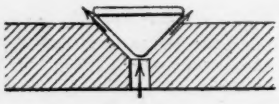


Fig. 2.

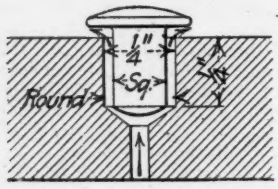


Fig. 3.

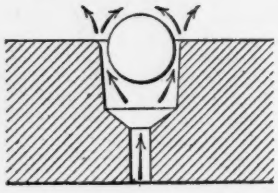


Fig. 4.

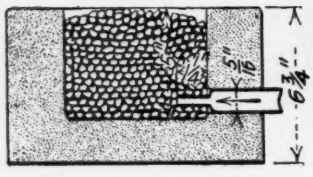


Fig. 5.

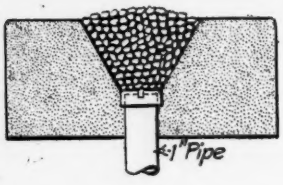


Fig. 6.

Forms of Baffled Combustion.

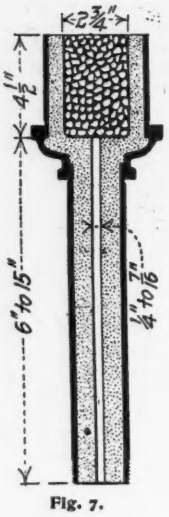


Fig. 7.

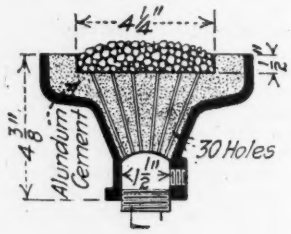


Fig. 8.

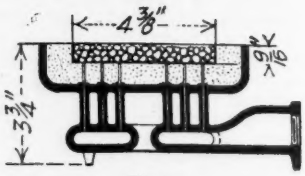


Fig. 9.

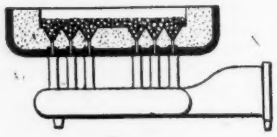


Fig. 10.

Three Forms of Domestic Flameless Gas-Burners.

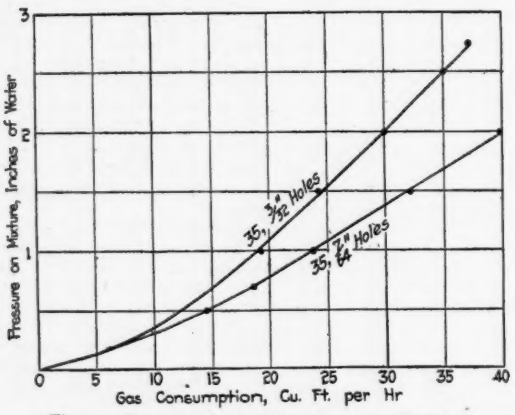


Fig. 11.—Pressure Combustion Curves for Flameless Gas-Burner, fig. 9.

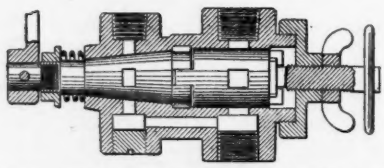


Fig. 12.—Section of Double-Ported Mixing Valve.

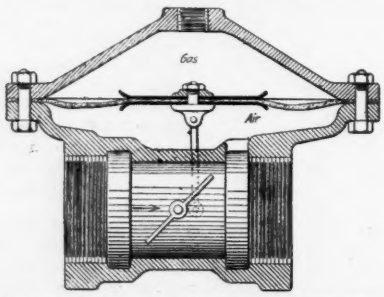


Fig. 13.—Section of Air-Pressure Regulator.

pressure, and that heat flowed back through the walls to heat the mixture passing through. The mixture passage-way could be at any temperature without harm if of uniform bore, and if when cold the flow velocity was great enough to prevent back-flash. It was found that the length of uniform-bore feed-pipe that would be cool enough at its supply end to be safely joined to a header or box was greater for large than for small holes, and that the allowable length was a definite number of diameters. For instance, with the apparatus shown in fig. 7, a single refractory lined tube having a hole ¼ inch diameter and 6 inches long could be operated indefinitely at 7-inch water pressure, whereas a hole of 7-16th inch diameter, but of the same length, flashed back at 1·5 inches water pressure, and continued to do so even after the length had been increased to 15 inches. Small-diameter orifices (1-16th inch), with about 1½-inches length, have been operated indefinitely on pressures as low as 0·2 inch.

Control of Intensity of Combustion.

The question of the control of heat generated per square foot of fire-bed seemed at first a more elusive matter than the prevention of back-flash through nozzles. The two problems really are related, though the relation is not so clear as it might be. The first was: At how high an intensity might gas be burned, and how might the structure be formed, to permit steady supply and combustion? The second problem was as to how such a burner might be turned down to a so-called "simmering-point" without giving trouble.

When the whole cross section of fire-bed is taken up by the combustion zone, gas mixture is being supplied as fast as it can be burnt within the space available; and any increase in the rate of supply will result in blow-off. It is necessary that when everything is cold the mixture shall be supplied at a lower rate, and then after the bed is heated its accelerating effect on combustion may be used to localize a very much increased supply. As an illustration, the results of a single series of tests on the apparatus shown in fig. 7 will serve. The pressures were never extended above 12 inches of water at the point of mixture supply, and began with a single 5-16th inch hole, discharging into a cylinder 2¾ inches in diameter with an area of 6 square inches. As increase of pressure up to this maximum noted failed to supply as much mixture as could be consumed in the available area, a second, a third, and finally a fourth hole was added, even then without reaching the limit of consumption. With four holes and a pressure of 10½ inches of water, the rate of combustion of 2460 cubic feet per square foot per hour was reached. The gas had a calorific value of 600 B.Th.U. per cubic foot, which showed 1,584,000 B.Th.U. per hour per square foot of fire-bed. There was no indication that the limit had been reached; but the rate was so high as to give trouble with the available refractory material, and the series was not carried beyond. The conclusion is that higher rates of combustion than have been known are now easily obtainable, and rates higher than any common refractory material can resist. Hence, if any service arises that demands such rates of heating, the need can be met. Of the several refractories tried, the most satisfactory found was white alundum, with linings of alundum cement.

The most difficult problem was to find a suitable structure for permanent localization of the combustion surface with very low supply pressures with uniform incandescence at the surface. Long series of experiments showed the failure of the single-point supply to distribute the mixture so as not to flash-back and yet uniformly to heat the top of the radiating bed under low rates of combustion. It was concluded that multiple-feed orifices must be used with a surface bed of sufficient thickness to localize the combustion and equalize the spotty appearance. Since it was shown that a single long feed-hole could be proportioned permanently to resist backward heat-flow, it followed that several feed-holes might be grouped so as to be fed from a common point; discharging the mixture at the other end over as large an area as needed for any desired surface rate of combustion, but resisting flash-back.

This was the basis of construction shown in fig. 8. The holes were moulded in alundum cement by wires held in place in the end radiating from a bottom chamber. The distance between the

feed-chamber and the hearth is long enough, so that the dissipation of heat from the side walls will balance the heat carried down through the solid material. A reasonably practical burner for cooking-stove service was evolved from this design; there being 34 1-16th inch holes spaced in three rings. On the hearth was a bed of white alundum ½ inch thick. The dimensions were selected to give a consumption near that of the standard top burners of ordinary gas-cooking stoves—15 cubic feet per hour under 2½ inches water pressure. The arrangement gave a uniform top heat, and was operative at low pressure for an indefinite time.

To show the adaptability of this general type of construction, other burners were manufactured. One of these, with a 6 in. by 10 in. hearth, was intended for use below an assay muffle. To show how this could be extended to large areas without excessive length of holes in the solid group, three wedge-shape sections, each 1 ft. by 3 ft. were used to make a hearth of 9 square feet. This was tried in the firebox of the Baldwin locomotive in the mechanical engineering laboratory at the Columbia University. Mixture was supplied through a 12-inch header to three 5-inch branches, one to each burner section. At 10 inches water pressure, the rate of combustion would be 20,000 cubic feet of gas per hour—an intensity of 2230 cubic feet (1,338,000 B.Th.U.) per hour per square foot of firebed area.

The trouble of moulding holes in the refractory material between hearth and feed-box, and the ease with which large sections may be broken, led to a search for a better form. The holes through which the mixture is to be supplied have to be cooled, but so spaced as to give the proper distribution of heat. Forming the holes in independent tubes was logically a more effective scheme. This has been incorporated in burners which seem to be satisfactory commercial forms for all sorts of surface-combustion apparatus. One such, designed as the top burner for a domestic cooking-stove, is shown in fig. 9. The casting is drilled, wires are inserted in the drilled holes, and the lining pressed into place around them. On removing the wires, the cement forms a perfect hole for the hearth exactly registering with the drilled hole in the casting. The burner shown has 35 1-16th inch holes; but other diameters have been used, and other material for beds of various thicknesses. The consumption and top temperature for each vary; and any result desired by the designer can be obtained by the proper selection of dimensions. The gas consumption for two such is shown in fig. 11. Inverted burners, with 60 1-16th inch holes in two rows and a long narrow hearth with loose granulated material held in place by wire-mesh screens, have been used, giving a bright broiling heat with excellent service. The same screen construction has been used with a vertical curved-face room-heater. A hearth 8½ in. by 5 in., supplied by 72 holes, gives as intense a radiation of heat as is safe. The same use of independently cooled feed-holes, with metal walls and registering orifices in refractory hearths, has been applied to high-rate appliances such as muffles. The same castings can be used for a wide range of capacities by changing the drill sizes. In special muffles, easy control of the temperature gradient through the furnace is secured, irrespective of the flue, by changing the quantity of mixture supplied to different points.

As shown by the foregoing, it is possible to make a surface-combustion burner for any desired intensity of combustion to operate for indefinite periods without disturbance or adjustment; but with commercial apparatus it must be possible to adjust the consumption of any burner from a minimum low to a maximum high rate, and to operate safely and surely at any point.

Some classes of service require very prompt change in the temperature of the radiating bed after adjustment, including a very quick initial heating after lighting cold; other classes of service require a slow change. Sluggishness is obtained with a thick bed of large heat-storage capacity; sensitiveness comes from the use of as light beds as possible. But too great reduction in thickness may leave the bed so thin that it is no longer effective in reducing mixture velocity at the orifices, and the mixture will blow-off at various points where the grain does not properly baffle. The escape of this unburnt mixture reduces the amount of heat developed, delays the heating, and smells. Apparently reduction in size of grain corrects this; but limits to its use are met. The grain must not be so small as to fall into the end of the orifice; a thin layer of fine grain will not heat uniformly with hole-spacing satisfactory for larger grain. The fine-grain bed heats from the surface inward, while the coarser grain heats from the inside outward. With two such beds of equal weight of material, the one that heats from the outside first will be quicker because of the non-escape of unburnt mixture while heating.

This has led to a successful form of quick-heating top burner which becomes uniformly incandescent in about half-a-minute, compared with three or four minutes for the ordinary ½-inch thickness of large grain bed. This one is formed by counter-sinking the outlet side of the feed-holes, filling the taper holes with 10-64th to 2-64th inch grain, and covering the hearth to a depth of ¼ inch.

A quick-heating type of construction is that of the formed baffle over which is placed a radiant screen of perforated or woven metal, a thin layer of loose grain, or a refractory diaphragm. A nickel-chromium-iron alloy has been most used as the screen over ball baffles. This construction may be a direct competitor of the electric heater, using the same radiant material at the same temperature. These plates have a fair life if not operated at too high a temperature. A gas consumption of about 0·5 cubic foot per hour per square inch of radiation surface is a satisfactory rate, and gives a good red heat. These are heated-up in 10 seconds. It is a serious question whether the reduction of heating-time should be carried so far, even in domestic apparatus, because of the corresponding small heat storage.

The application of the bonded diaphragm is a problem in itself, as the localization of combustion is not so readily controlled under wide ranges of mixture pressures. All such diaphragms, except those of great porosity and thickness, will heat from the outside inward. The combustion zone will finally locate between the hearth and the bottom face of the diaphragm. Up to the moment of ignition below the diaphragm, the outer surface has been hot and radiating; but now the heat will be practically all absorbed by the hearth and support until these become incandescent. During this period, the top radiating surface will cool, afterwards slowly recovering its temperature, when it will operate indefinitely without change.

Many diaphragms of all sorts of grain materials and bonds have been tried, and all abandoned in favour of alundum. The results of tests for one series of alundum diaphragms will illustrate the action. These were 5⅛ inches diameter, 7-10th inch thick, set in a hearth over 35 1-16th inch holes. The time of recovery of surface temperature varied considerably; but in the best the whole time was about five minutes. In some cases it reached 15 or 20 minutes.

Auxiliary Apparatus.

Air under pressure is always necessary for the operation of these combustion appliances; but the pressure need be no greater than is easily obtainable with electrically-driven fans. Where furnaces have skilful operators, there need be no special appliance for proportioning air to gas in the mixture, or for changing the mixture pressure as service conditions may require. Therefore any of the standard fans and blowers may be used for compressing air alone or air and gas separately with a hand-adjusted cock in the air and gas pipes. The more pressure there is, the more definite the proportioning and the smaller the valve needed. To permit of adjustment to changes of quality in gas, one port is made of fixed size with the other adjustable (fig. 12), though in opening and closing both vary in constant ratio. It is not expected that users will make this adjustment. Equalization of gas and air pressures has been accomplished with a damper valve (fig. 13) in the main air passage, attached to a diaphragm regulator connected to the gas line.

About 1 inch water head is desirable on the air for good regulator action. With the full available gas pressure used—say, 3 inches—the fan should deliver at 4 inches; but with mixture pressures as low as 1½ inches satisfactory operation can be secured. This would require a gas pressure less than 2 inches and fan delivery at less than 3 inches. The power required for such a fan is so small that any lamp-socket would serve for any domestic appliance, even a large range. Where there were several appliances to be operated, air might come from a single fan.

Efficiency.

It is found that the absolute and relative efficiency of surface-combustion and bunsen-burner appliances is not constant, but varies with local conditions. For this reason the figures given are confined to domestic appliances operating on city gas, all made by removing bunsen burners from standard appliances and substituting surface-combustion types. Data from a large mass of tests conducted with various bed materials and thicknesses, different shapes, sizes, and materials of vessels, different distances between bed or flame and vessel, at all sorts of gas or mixture pressures, show such variations to be perplexing at first to one seeking some definite general conclusions on the relative values of the two systems. Careful analysis, however, reveals some order under as nearly identical conditions as differences in the two systems permit. The surface-combustion burners always do an equal amount of heating of water with less gas than the bunsen, but how much less seems to be dependent upon the construction of the burner, stove-frame, and water vessel. Perhaps the most important of these external conditions is the vessel itself. The best judgment that can now be formed is that, taking into consideration all probable conditions, there may be expected an average consumption ratio of bunsen to flameless indicating a saving about 35 per cent. of what is now being used.

The question naturally arises as to when the saving of gas becomes large enough to pay for the electric current consumed by the fan, and at what time the net saving will pay for the increased cost of surface combustion appliances over the bunsen type. The last question is answered only when it is known how much the appliance will be used, as the fixed charges per hour of use depend upon the number of service hours per annum. If it is to be used one week a year, it matters little how efficient it may be, and the cheapest thing in first cost available is the thing to buy. An appliance that is used every day, however, will pay for the extra cost, and doubly so, if operated many hours in the day on service requiring gas. All sorts of hypothetical calculations may be made; but one short way of disposing of the electrical cost is to consider that the gas saved by a single top burner (domestic range) will more than pay for the electric current to operate an entire range, so that for all burners in operation in excess of one the electric current costs nothing. Only results with New York city illuminating gas are reported, though work with other fuels permits the statement that all gaseous or liquid fuels are equally available.

COMMERCIAL TESTS OF INTERNAL COMBUSTION-ENGINES.

THIS was the subject of a paper read by Mr. W. A. TOOKEY before the Institution of Mechanical Engineers last Friday. During the past few years the author has made tests of more than 700 gas-engines, of various sizes and types, working with town gas, within the London area; and he described the method adopted by him to enable reliable comparisons to be made respecting the performances of these widely differing engines. The following are the principal portions of his paper.

The author began by pointing out that the circumstances under which gas and oil engines are operated when installed in factories usually preclude an engineer from carrying out any desired tests upon the exact lines which have been suggested by committees of engineering institutions in England, Germany, and America, and which have been formulated with the object of effecting a standardization of results by means of which proper comparisons can be made. No direct measurements can be taken of the quantity of heat absorbed by the cooling water or rejected in the exhaust; nor is any direct measurement of the air admitted into the cylinder practicable. In fact, it is rarely possible to do more than measure the gas consumed or weigh the liquid fuel, and to indicate the engine with due care.

OBJECT OF THE INVESTIGATION.

An extensive series of tests was undertaken by the author on behalf of the Gaslight and Coke Company, and also, and in greater numbers, for the South Metropolitan Gas Company. The objects in view were to note the performances of the engines in their condition "as found," to improve such performances when it was possible to do so by adjustments of mechanical details, and to report whether still further improvements could be expected if proper attention were paid to necessary repairs or renewals of worn parts. The two Companies concerned realized the fact that many of the thousands of engines used by their consumers were expected to work year in and year out with the very minimum of attention beyond starting, stopping, and lubricating; and therefore it was to their interests, though indirectly, to ensure that the utmost work could be obtained from the least volume of gas. The whole cost of the survey was borne by them; and that the consumers have benefited very considerably will be evident from the following statement.

Up to October last, the number of engines inspected and reported upon was 763. A considerable proportion were found to be well looked after, and maintained in such good order that very little improvement was possible. On the other hand, some had been so neglected that no improvement could be effected without previous more or less extensive overhauling. Quite a number of old-type slide-valve engines are still doing good work with such moderate gas consumption that, for the amount of horse-power-hours developed, the savings in the cost of gas obtainable by utilizing modern gas-engines, despite the greater efficiency of the latter, would be insufficient to recoup the interest on capital outlay involved in their replacement. Examples of gas-engines have been met with the mechanical details of which necessitated reference to early editions of standard gas-engine books—especially in the case of two-cycle engines with displacer cylinders, six-cycle double-acting engines, and others working upon the four-stroke cycle, but with complicated valve-gear that demanded some little study before one could appreciate their peculiarities.

It was found possible to improve the working of 66 per cent. of all the engines tested, merely by adjusting the gas or air regulation or by correcting the ignition timing and valve-setting. A greater proportion could have been improved had new parts been fitted, and had attention been given to matters which would involve stoppage for periods varying from a few hours to a few days. In all cases where renewals or overhauling appeared to be imperative, recommendations were made to the user to call in the makers or a firm of expert gas-engine repairers to put matters right. In some instances such improvements as could be made at the time increased the power developed per impulse as well as reduced the consumption of gas; in others, either the output or the efficiency, but not both, was increased. The average improvement as regards increase of power per impulse was 27 per cent. For example, an engine found to be giving a mean pressure of (say) 60 lbs. per square inch would be left giving 76 lbs. with the same, or even a decreased, gas consumption, under the same load and speed. The average reduction in gas consumption was 13·3 per cent. on the I.H.P.-hour basis.

METHOD OF CONDUCTING THE TESTS.

It was essential that all tests should be conducted in such a manner that no stoppage of the work of the factory in which the engine was fixed was involved; and, further, that the adjustments made should be such as would bring about improvements in working—not so much under "light" or "maximum" loads, but those which accorded with the average output in daily work. Following upon a preliminary inspection at which were noted the size, type, and make of engine, arrangements were made to fit up the indicating gear and check over the valve-settings during the midday meal hour. While this was being done, the opportunity was taken of noting whether the gas-meter index remained stationary while the gas-bag was kept fully distended and with the ignition-tube burner turned off. Any variation noted in the interval gave the rate of leakage, if any, in the supply pipes.

After the indicator gear had been properly fitted and the valve-settings taken, the engine was started up, and very shortly after (as soon as a trial card had been taken and examined) other diagrams were obtained. At the same time the impulses per minute and the number of revolutions per minute were counted, and the gas consumption per minute was noted while the engine was running without any load except that due to the main driving-belt running on the loose pulley. This trial was known as "light, as found." The shop load having been put on, a similar series of observations were taken and noted as "load, as found." Diagrams referring to the latter were then worked out on the spot, and calculations were made to note the mean pressure obtained with respect to the mixture strength.

From the previous checking of the valve-settings and the information afforded by the "load, as found" cards, together with an examination of the curves recorded upon a diagram taken with a light spring, it was then possible to decide which, if any, adjustments should be made to bring about improved performances. Several diagrams were thereupon taken under different conditions, until it was determined, by means of temporary adjustments, exactly how to achieve the desired result. Occasionally the improvement could be effected within a short space of time; but frequently several hours were spent, according to the condition of the engine, before a satisfactory result could be obtained.

PARTICULARS OF THE TESTS.

The desired goal having been more or less nearly approached, the inspection was concluded with a final consumption test under normal shop load; and the comparisons then made of the initial and final ("as found" and "as left") results showed exactly what improvement had been effected. A record or test-sheet was then made out, and from this a report was drawn up and sent to the gas company for the information of the consumer. Such report was not so detailed as was the test-sheet, as the engine proprietor could not be expected to appreciate the value of all the figures upon the latter. The report therefore merely gave the comparative "as found" and "as left" figures, with a brief statement of the condition of the engine, with suggestions as to repairs, &c., required to obtain still further improvements. These particulars, which refer to a 24-inch by 30-inch engine, are detailed in the following table.

TABLE I.

	Load, as Found.		Load, as Left.
Impulses per minute	67·50	..	64·70
Cubic feet of gas per minute	46·20	..	43·60
Impulses per cubic foot	1·46	..	1·48
Charge volume per cubic foot	12·32	..	12·49
Mixture strength, B.Th.U. per cubic foot	40·55	..	40·00
Mean pressure, pounds per square inch	87·50	..	95·50
Factor: $\frac{\text{mean pressure}}{\text{mixture strength}}$	2·158	..	2·388
Indicated horse power	202·40	..	211·80
Cubic feet of gas per I.H.P.	13·70	..	12·36

Observations.—Diagrams "load, as found" showed late firing, which was corrected by advancing the ignition of both magnetos—one by one notch and the other by two notches. Anti-pulsator valves in both gas-bags were not working freely, and diaphragms were flabby. The exhaust-valve was opening early and closing very late. Instructions were left with attendant to correct this.

In order to show clearly the method by which proper comparison between the performances of each of the engines was made possible, some explanation is necessary. The author's experience with internal-combustion engines has indicated that, while the strength of the mixture taking part in combustion has rarely, if ever, been considered in authoritative trials, yet this is one of the most important matters which should be determined in all tests. In "Engineering" for Oct. 15, 1909, the author contributed to the correspondence columns of that journal a lengthy analysis of the figures given in the third report of the Gas-Engine Research Committee of the Institution, and it showed that the influence of mixture strength upon the thermal efficiency of internal combustion engines was of at least equal importance to the compression ratio. In the contribution he described how the mixture strength could be computed, and from the comparisons then possible gave the conclusions that equal thermal efficiencies can be obtained throughout a wide range of compression pressures, and also from varying mixture strengths, provided that ignition is properly correlated, and that by increasing the mixture strength and delaying the firing-point, higher mean pressures can be obtained with little, if any, loss of efficiency within certain limits.

Since the date of that contribution (1909), the author has had many opportunities of putting these conclusions to the test of practical work, and is more than ever convinced of their soundness. Throughout the extensive series of commercial tests alluded to in the paper, the mixture strength of the charges taken in by the various engines has been computed in terms of total cylinder

contents—that is to say, gas, air, and residuals—and then compared with the mean pressure (positive loop) calculated from indicator diagrams. The factor, $\frac{\text{mean pressure}}{\text{mixture strength}}$, thus obtained has been an invaluable aid in deciding what steps to take to obtain better performances from all the engines inspected. In order to express the mixture strength in terms of total cylinder volume, however, it is necessary to know the clearance volume as well as the piston displacement. The latter can be calculated at once from the cylinder dimensions of an engine; but the former, in commercial tests, cannot be definitely measured. A close approximation can nevertheless be obtained by observing the compression pressure attained, and also by noting the volumetric efficiency of the engine.

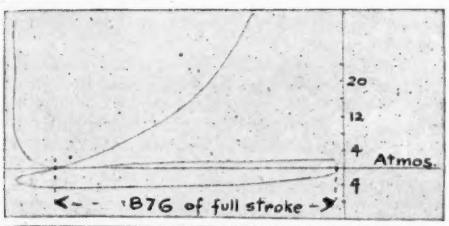


Fig. 1. *Determination of Volumetric Efficiency.*

Fig. 2. *M.E.P. 87·5 lb. Late ignition of charges, "load, as found."*

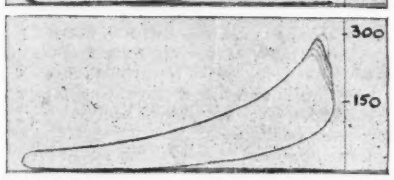


Fig. 3. *Earlier ignition in consequence of adjustment of both magnetos by one notch.*

Fig. 4. *Ignition of charges "load, as left," by back end magneto being further advanced by one notch.*

Figs. 5 and 6. *Refer to test as Table 2.*
Fig. 5. *"Load, as found" rapid ignition due to early firing and rich mixture. Compare Fig. 6.*

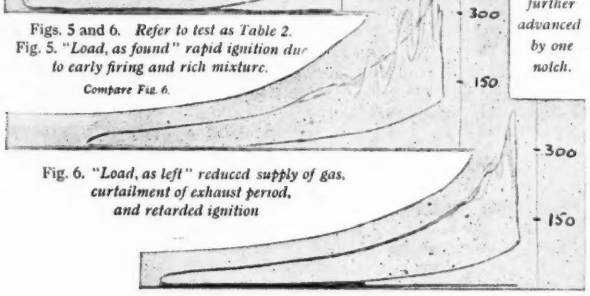


Fig. 6. *"Load, as left" reduced supply of gas, curtailment of exhaust period, and retarded ignition*

Internal Combustion Engine Tests.

[Figs. 1 to 4 refer to the Test as Table I.]

Fig. 1 shows a light spring card taken from the engine referred to in Table I. It will be seen that the point along the atmospheric line at which the compression curve crosses the latter is alone taken into account; for at this point it is clear that the whole of the cylinder is filled with a mixture of gas, air, and residuals at atmospheric pressure and at some indeterminate temperature. In this engine the specific piston displacement was 7·85 cubic feet, and the effective piston displacement was 7·85 × 0·876 (volumetric efficiency) = 6·88 cubic feet. The compression pressure attained was 120 lbs. above atmosphere, or, in round figures, 135 lbs. absolute. Taking the atmospheric pressure as 15 lbs. per square inch, the compression pressure ratio was 9; and assuming the exponent of the compression curve to be 1·30, the total cylinder volume must have been 5·4 times that of the compression volume. Therefore it can be computed that the effective piston displacement, 6·88 divided by 5·4 − 1, or 4·4, will give the content of the clearance space with fairly close approximation to accuracy. Thus the figure 1·56 cubic feet is arrived at for the clearance space, and that of 8·44 cubic feet for the effective cylinder volume.

The number of impulses being noted for the various tests, as also the amount of gas registered by the meter in cubic feet, both expressed on a similar time-basis, the division of the latter into the former will give the number of impulses obtained per cubic foot of gas. In Table I., for the "load as found" count, it will be seen that the figure 1·46 is thus obtained. Therefore 1·46 multiplied by the effective cylinder volume, 8·44, gives the number of cubic feet of stuff with which 1 cubic foot of gas is mixed—viz., 12·32. If then the calorific value of the gas be known—in this case 500 B.Th.U. per cubic foot*—it can be computed that the calorific value of a cubic foot of stuff in the effective cylinder volume is 500 ÷ 12·32 = 40·55 B.Th.U. The diagram fig. 2 shows that, upon ignition, this strength of mixture gave a mean pressure of 87·5 lbs. per square inch, or 2·158 lbs. for each B.Th.U. per cubic foot of mixture. To one who is in the habit of checking the performances of internal-combustion engines in this way, the value obtained for the factor $\frac{\text{mean pressure}}{\text{mixture strength}}$ at once indicates that the engine was doing well in respect of economy, and that usually no betterment can be expected, under ordinary working conditions, by adjustment.

From the diagram, however, it will be seen that the ignition was somewhat late. An attempt was made to correct this by accelerating the low-tension spark from both magnetos with which the cylinder was equipped; each lever being moved one notch forward. The result is shown in fig. 3. Even with this acceleration, while improved, the ignition was still somewhat late, and consequently the magneto which was situated at the back end of the combustion chamber was further adjusted by moving the control lever one notch further in advance. The diagram then obtained (fig. 4) was satisfactory; the slight variations in successive cycles noticeable at the top of the card being attributable to the irregular movements of the anti-pulsator valves in the two gas-bags provided.

The next step was to determine what effect these ignition adjustments had upon the gas consumption. The "load, as left" count was therefore taken, with the result shown by the series of figures in the lower line of Table I. The factor is there found to be 2·388—a most satisfactory value.

Naturally, the assumptions necessary for obtaining this factor in commercial tests will not permit acceptance of the figures as being absolutely accurate; but, being recognized as but an approximate standard of comparison, the factor will, for test-bed work and for general purposes, be found particularly useful. It shows very clearly whether any engine is or is not doing well, whether the mixture employed is too strong, and also what influence ignition-timing, prevailing skin-temperature of the cylinder walls, and deliberate adjustments have upon the performance of any engine under observation.

Importance of Volumetric Efficiency and Mixture Strength.

In many cases published results of tests have not hitherto included volumetric efficiency of the engines, nor has any standard been authoritatively approved of the measurement of volumetric efficiency. Usually, however, the latter has been determined by referring to the length of the atmospheric line between the two points where the suction and compression lines cross the atmospheric as a percentage of the total length of the indicator diagram. This is incorrect for the purpose of computing clearance volume and mixture strength on the lines indicated. The importance of taking volumetric efficiency into account is very marked, and particularly in connection with engines governed by throttling the mixture, as, with the same clearance volume, lower compression pressures are then attained.

In one test made by the author, a vertical gas-engine, which was designed to work at 100 lbs. (say, 115 lbs. absolute) compression pressure, attained at its maximum normal full load, three-quarter load, and half load, 96, 92, 78, and 73 lbs. per square inch respectively. The volumetric efficiencies at each compression pressure were respectively 88·2, 83, 80, and 76·5 per cent. Assuming the exponent η in $\frac{P}{p} = \left(\frac{V}{v}\right)^{\eta}$ was 1·30, the clearance volume at 100 per cent. volumetric efficiency for a piston displacement of 0·55 cubic foot (cylinder 11 inches diameter by 10 inches stroke) would be 0·145 cubic foot; and the total cylinder volume 0·695 cubic foot; the clearance ratio—total cylinder volume (piston displacement *plus* clearance) divided by clearance volume—being 4·8. At 96, 92, 78, and 73 lbs. compression pressure, the clearance ratios would be respectively 4·7, 4·5, 4·05, and 3·9 ($\eta = 1{\cdot}30$), and with the clearance volume common to all at 0·145 cubic foot as before, the effective piston displacements for each ratio would be 0·535, 0·5065, 0·4410, and 0·4193, each of which is equivalent, in respect of the specific piston displacement of 0·55 cubic foot, to the volumetric efficiencies determined by the indicator. For the purpose of computing total cylinder capacities, therefore, as long as the compression pressure and volumetric efficiency are known, the compression ratio can be determined, and the clearance volume ascertained therefrom, with reasonable accuracy for commercial testing, as exemplified in connection with Table I. The compression curve exponent 1·30 appears to hold good for engines widely varying in design, within close limits.

The author has frequently been impressed by the fact that, in the majority of scientific investigations reported to engineering societies, all references to mixture strength have been omitted. In saying this he is, of course, aware that some exceedingly ingenious methods have, on rare occasions, been adopted to determine the volume or weight both of air and of gas, or air and

* The average calorific value of gas distributed by the "ring" mains of the South Metropolitan Gas Company, into which all their stations feed, is approximately 500 B.Th.U. per cubic foot, and practically constant at this figure.

petrol, &c., that have been drawn into engine cylinders, in order to state the ratio of one ingredient to the other. But, in practice, the combustible forms part of a mixture of air, gas, and residuals, and it is probably because of the difficulty in measuring the latter that the hitherto existing lack of information is due. Without a knowledge of the mixture strength with which the engine is working, and also the mixture strength at which the engine works best, the internal-combustion engineer cannot even be certain that the test-bed adjustments are final; for if—for example, when the engine is put into regular operation—an undue increase of cylinder-wall temperature occurs, the performance of the engine will be likely to cause trouble, more especially should richer mixtures be admitted than those for which the ignition timing has been "set."

Further Results of Tests.

The large number of tests systematically made during the survey already referred to provides many valuable data which cannot be presented in a complete form in the paper; but a selection of test results, taken almost at random from a number of engines of varying cylinder dimensions and compression ratios, may be presented and discussed.

Table II. reproduces a portion of the test-sheet of a small gas-engine (5 inches by 12 inches).

Table II.

	Light, as Found.	Load, as Found.	Load, as Left.
Impulses per minute	47·60	95·70	111·80
Cubic feet of gas per minute	0·718	1·50	1·31
Impulses per cubic foot	66·40	63·40	85·40
Charge volume per cubic foot	10·26	9·90	13·25
Mixture strength, B.Th.U. per cubic foot	48·25	50·25	37·75
Mean pressure, pounds per square inch	103·00	92·00	91·00
Factor: $\frac{\text{mean pressure}}{\text{mixture strength}}$	2·133	1·83	2·41
Increased horse power	2·92	5·25	6·05
Cubic feet of gas per I.H.P.	14·75	17·15	13·00

Observations.—Engine had been recently overhauled. "As found," the mixture was too rich, involving heavy bumping on ignition. The exhaust valve was opening very early and closing after the gas-valve opened. The ignition had too much lead and was retarded.

Here it was found that for "load, as found," the factor was 1·83. The diagram fig. 5 shows that "as found" ignitions were extremely rapid. The effective cylinder volume per cubic foot of gas was somewhat low—viz., 9·9 cubic feet. Therefore the adjustments made were to retard the lead of the magneto ignition and to diminish the gas supply. Another point that the light spring cards drew attention to was the ill-effect caused by the exhaust valve opening too early and closing too late. Adjustment was therefore made to curtail the exhaust period. The effect of these slight alterations is shown in the "as left" diagram, fig. 6, and in the "load, as left" line of Table II. It will be seen that a cubic foot of gas then sufficed for 13·25 cubic feet of effective cylinder volume, and the factor rose to 2·41. So that in this small engine, of 0·1365 cubic foot specific piston displacement per stroke, almost equivalent efficiency was obtained as in the larger engine of Table I., of nearly sixty times the cylinder capacity.

It is interesting to notice the relative figures in this test when the engine was running "light, as found." With no variation due to deliberate adjustments, but consequent merely upon additional load and less frequent internal cooling by means of consecutive idle strokes or scavenging cycles, the factor of 2·133 was reduced to 1·83. It will be noticed also that, though the mean pressure was higher at "light, as found," yet this was obtained by a somewhat weaker mixture than "load, as found." That still further reduction of mixture strength was advisable to obtain higher efficiencies under the prevailing conditions is clearly shown from the "load, as left" factor. Incidentally, it may here be pointed out that the factor as used by the author enables an experimenter to observe with great practical benefit the actual variations of mixture strength consequent upon normal variations of conditions peculiar to all internal-combustion engines, and their effect upon efficiency, &c.

Table III. is an abstract from the test-sheet relating to a gas-engine of about the average size in general use in London factories (11½ inches by 18 inches). In this instance, the engine was found to be working so well that no improvement could be effected. It is interesting to note that the value of the factor is slightly higher than that noted in Table I., though the cylinder dimensions of the latter were more than seven times as great. Similarly, the factor is comparable also with the small engine in Table II., though the latter was but one-eighth the size, reckoned in terms of cylinder capacity.

Table III.

	Load, as Found.
Impulses per minute	45·14
Cubic feet of gas per minute	5·45
Impulses per cubic foot	10·15
Charge volume per cubic foot	12·08
Mixture strength, B.Th.U. per cubic foot	41·40
Mean pressure, pounds per square inch	100·50
Factor: $\frac{\text{mean pressure}}{\text{mixture strength}}$	2·43
Indicated horse power	21·40
Cubic feet of gas per I.H.P.	12·50

Observations.—Engine practically new. Temporary adjustments to mixture regulation and ignition timing resulted in no improvement, and engine was left, "as found."

Very efficient cooling and careful adjustment of ignition-timing devices are required when engines are called upon to deal with loads necessitating a continuity of explosions producing mean pressures of the order of 90 lbs. per square inch. As will be sufficiently clear from the examples already referred to, such high pressures are not at all uncommon in every-day work (the author has obtained as much as 118 lbs. per square inch from an engine lightly loaded, and taking a scavenging charge after each power cycle); and there is little doubt that gas-engines rated by the makers upon the basis of 80 lbs. per square inch for continuous work actually possess a considerable reserve of power. Unfortunately, the manner in which engines can be run at such overloads is very rarely understood by men in whose charge they may be placed; while, until recent years, no facilities were provided by means of which the necessary adjustments could be made to achieve this much-to-be-desired end.

The only limit to an engine's capacity for overload within the range above mentioned is the liability to pre-ignition of the charge during the final portion of the compression stroke. The more nearly the temperature reaches a certain critical point, either by heat generated during compression or by cylinder-wall radiation, practice seems to promise higher efficiencies. The output of power depends upon the mixture strength. The richer the mixture the more powerful the impulse, in terms of mean pressure. But if the load demands a mixture so rich that the combustion, when once started, proceeds with extreme rapidity under the temperature due to compression and wall radiation, then pre-ignitions are set up spontaneously, and announce their existence by violent bumping, and quickly bring the engine to a standstill if allowed to continue.

It is for this reason that engines governed on the "hit-and-miss" system can work continuously at high mean pressures without giving trouble. Even if but one miss occurs at intervals of (say) twenty cycles, the engine will work quite satisfactorily under such conditions, probably due to the fact that the air, admitted during the "governing cycle" or "miss" in a state of turbulence, effectively cools the skin of the internal wall below the critical temperature, which water circulation alone is not able to reduce.

Pre-ignitions are much more likely to give trouble when engines are throttle governed, for, under heavy loads, the compression pressures and temperatures are higher, and more heat is given to the walls. But, even then, with copious water circulation, and with properly retarded ignition (suitable to the load), overloads requiring upwards of 90 to 95 lbs. mean pressure can be carried for quite considerable periods.

Conclusions.

The author is of opinion that, judging by his own experience, internal-combustion engine makers will find that the factor value suggested in the paper will be most useful to them in tuning-up their engines. Tables can be prepared for the use of the test-bed staff which will give definite figures without any calculation for effective cylinder volumes corresponding with actual volumetric efficiencies. Then, with diagrams obtained by means of correctly set reducing gear and with instruments of fair accuracy, the factor value can be calculated from the following formulæ:

(1) $H \times F \div I \times V = S$. (2) $P \div S = \text{factor}$;

in which—

H = average calorific value of fuel per pound or cubic foot.
F = pounds or cubic feet of fuel consumed per minute.
I = impulses per minute.
V = effective volume of cylinder in cubic feet.
P = mean pressure in pounds per square inch.
S = mixture strength in B.Th.U. per cubic foot.

The term S will be a direct guide to the relative mixture strengths admitted to every engine; and, this being known, many phenomena hitherto held to be inexplicable will be made clear to those engaged on the test-bed. With a certain setting of the gas-regulating valve or its equivalent, the standard mixture strength for which the rated powers apply can be readily obtained, and the air adjustment can then be regulated so that proper combustion ensues. With a mixture strength of (say) 40 B.Th.U. per cubic foot, a mean pressure of 80 lbs. per square inch can be definitely relied upon; and, given sufficiently close adjustment of ignition timing, even 90 lbs. or more can be secured without risk of pre-ignition, provided that the compression pressure is not too high, and the internal cylinder walls, &c., are efficiently cooled.

When it is realized, as various test-sheets in the author's possession show, that mixture strengths of 50 and 55 B.Th.U. per cubic foot of effective cylinder volume can be efficiently burnt in gas-engine cylinders, which will give a proportionately greater power without loss of efficiency, it will be recognized that gas-engines rated on 80 lbs. mean pressure possess a capacity for overload far greater than has usually been conceded to them. To obtain this overload capacity, however, it is essential that means of control of ignition and combustion of mixture should be provided by makers. Ignition-tubes with timing-valves must be abandoned in favour of some form of electric ignition device that shall be adjustable. When the utmost efficiency must be maintained, gas-engine drivers should be encouraged to take indicator diagrams from time to time when noting the consumption of gas, and thus obtain the factor value. For this purpose the supply of gas, whether town or producer gas, to each and every engine should be

passed through meters. The arithmetical problems are of the simplest description, and can be done expeditiously.

DISCUSSION.

The discussion was not one that can be well reported without the formulæ freely scattered over the blackboard by the speakers and the curves exhibited. We will not therefore attempt a report in the ordinary way; but an indication of the trend of the discussion must suffice.

The PRESIDENT (Sir H. Frederick Donaldson, K.C.B.) congratulated both the author and the Institution on the character of the communication.

Mr. LEONARD MURPHY felt that Mr. Tookey had done very valuable work. The tests were of an extremely practical, and, one might add, of a scientific nature, because, after all, the really practical test was one in which the things that did not matter were eliminated in a scientific way. Rule-of-thumb tests were by no means scientific; but he might refer to Mr. Tookey's tests as not only scientific, but practical. However, he (Mr. Murphy) would be very envious if Mr. Tookey could show that his figures were as accurate as he claimed. He had gone to some considerable trouble in explaining to them the meaning of his factor; and no doubt that factor would be of considerable use. At the same time, he thought there were other factors that came into consideration. He also commented on Mr. Tookey's conclusion that, by increasing the mixture strength, and delaying the firing-point, higher mean pressures could be obtained with little, if any, loss of efficiency. They were led to believe there that, for some mechanical reason, the thermal efficiency of the engine was not quite so important as had been thought, and that they could get the same amount of power and a higher mean pressure with late ignition as with early ignition. This raised the whole question of compression volume, in regard to which Mr. Tookey left them in the dark as to whether he intended to mean that the maximum practical efficiency was got out of the engine. Makers designed their engines as a rule so that they did not work up to the limit of the compression pressure; and therefore presumably in the practical engine the ignition might be varied for a certain distance with the compression pressure at the same time giving the same result—not necessarily the highest. The ideal engine might be designed for a given compression, but this particular engine would not have its efficiency improved by any juggling with the compression volume and the timing of the ignition. One of the most valuable features of the paper was that the author was egging the manufacturers on to produce a higher efficiency; and it was time that they saw something of this kind. In one place, Mr. Tookey referred to engines of a fairly considerable age running quite efficiently; and in another place he pointed out where a small engine was giving the same results as a large one. It had occurred to him (Mr. Murphy) that at times they would very much like to vary the compression volume. Some engineers had tried to do this before, but the applications they had made had been impossible. Mr. Murphy then threw on to the screen a drawing of an automatic variable compression device. He described its construction, and said he thought that we had now arrived at a time when some improvement of this kind had become very necessary.

Mr. C. A. RAINEY considered the idea of making tests of gas-engines under commercial conditions was a good one, in order that their full power should be realized. In view of the competition for power purposes, in his opinion all gas suppliers should follow the example of enterprise shown by the two companies mentioned in the paper. The user of a gas-engine required not only to know the number of cubic feet of gas passing through an engine during a fixed period but the horse power he could obtain from it. In order to ascertain this, he must have suitable recording instruments which, like the engine, should be periodically tested. But all over the country, there were users who knew nothing of gas, and very little of anything else appertaining to their engines, except perhaps what power they wanted; and it was for this reason that he thought, if the gas undertakings of the country had a gentleman like Mr. Tookey to make engine inspections, tests, and recommendations, they would do themselves, the gas industry generally, and the users of engines a great deal of good. By taking such a course, some of the defects that had been referred to by Mr. Tookey would be minimized, if not completely eliminated. The maximum amount of power developed must depend upon the explosive mixture of gas and air. If the gas and air were not in the right proportions, no amount of coaxing of the engine would get the best results. The right mixture partly depended upon the weight of oxygen present in the air. The weight of the oxygen varied with the density of the air; and as the density varied hourly, it was difficult to get a proper measurement without having regard to the oxygen present. The waste heat of the cooling water could be checked by means of thermometers with recording charts fixed on to the inlet and outlet pipes. The waste heat of the exhaust could also be, more or less accurately, ascertained by similar thermometers. He proceeded to contend that, in the commercial running of prime movers, the present types of indicators could not possibly obtain records of each stroke, revolution, or cycle for more than a few minutes; and though repeated frequently, they must be more or less approximate. With the internal combustion engine, it was known that considerable variations occurred at every stroke, even when running with constant load. What was wanted for accuracy was a measurement of the pressure for every revolution or cycle made by the engine during the whole running time; and this had been rendered possible by a well-known German firm. They made a special instrument which recorded the pressures at every revolution or cycle. Its action was not limited by any period of time; its results might be checked at intervals if desired without any interference with the action of the power counter. In addition to giving records over long periods of running, it meant a considerable saving of time and money.

Captain RIALL SANKEY said that one of the main points brought out in the paper was the factor obtained by dividing the mean pressure by the mixture strength; and he thought it might interest those present to have this factor referred to thermal efficiency and the compression ratio. The speaker then covered the blackboard with formulæ, and commented upon them and a chart above; but without the formulæ and the chart before them what Captain Sankey had to say would not be very intelligible to readers. As a result of it all, we arrived at the Captain's opinion that the factor Mr. Tookey gave was a perfectly reasonable one, and that it ought to be called Tookey's factor. He regarded the contribution as one of extreme value.

Mr. E. J. DAVIS remarked that the author stated that the strength of mixture taking part in combustion had rarely, if ever, been brought into account in authoritative trials. In 1908, Professor Hopkinson gave a paper before the Institution on mixture strength and scavenging, and thoroughly threshed out the effect of various mixtures. He proved that with 8·65 per cent. of gas to the total air and exhaust, he got 12 per cent. more power out of a cubic foot of gas than when working with an 11 per cent. mixture—showing there was a thermal advantage in working with a weak mixture. This same point, he (Mr. Davis) proved in 1895 in a series of articles in the "Mechanical World." He then gave a simple formula by which the greatest advantage could be obtained out of a gas-engine, so far as the amount of gas necessary for running was concerned. The best mixture, he found, was 1 of gas to 8 of air. He thought the indicator was not a very necessary thing. For the last twenty years he had not used one. To suggest that gas-engine drivers should have indicators and work them would, he was afraid, simply mean loss of money and time to the employer.

Mr. F. J. PLATT, as a manufacturer, expressed his gratitude to Mr. Tookey for the work he had done. It would be to gas-engine makers and users of the greatest assistance.

Mr. CHARLES HAWKSLEY asked why, instead of making these tests during meal hours, they were not made on Saturdays and Sundays.

Mr. CHAMBERLAIN remarked that the author had referred to the difficulty, in making his tests, of fitting up the reducing gear within the space of an hour, and asked whether, in place of the ordinary reducing gear, he had ever tried a reducing wheel.

Mr. TOOKEY, replying first to Mr. Davis, said there was no doubt that mixture strength had been referred to in the proceedings of the Institution. The point he (Mr. Tookey) meant to make, and which he thought he had made in the paper, was that mixture strength, in terms of total cylinder volume, had not been dealt with so far as he had known. Mr. Davis's own contribution to the discussions on Professor Hopkinson's paper and the one by Professor Burstall, also brought out something of the same kind, when he said that, as the compression pressure went up, so the amount of gas going in had to be reduced. But he (Mr. Tookey) did not think it had been plainly stated that the mixture strength was calculable. The simple formula for which Mr. Davis was responsible referred, he thought, to engines that were working at their best; but it did not help them at all in finding out what engines were doing at their worst. It only enabled them to say what they should aim at. It did not make any allowance for variation of the calorific value of gas; it gave only the number of cubic feet of gas that one could expect to go into the engine and come out as power, without relation to the calorific value. The formula was, in his opinion, likely to be misleading. The formula he (Mr. Tookey) had put forward that evening not only related to gas-engines, but he had endeavoured to make it of universal application to gas-engines, petrol-engines, and liquid-fuel engines of all kinds. Nobody could express the working of an engine in so many cubic feet of gas. That would be of no use to a man interested in a petrol or a Diesel engine. What, therefore, he had tried to do was to submit a formula which would be of universal application to all types of internal combustion engines. As to the question of the use of the indicator in the hands of the more or less careless engine driver, he entirely agreed with Mr. Davis that to the ordinary engine driver, it would be the height of luxury to put such an indicator in his hands. But in the final paragraph of the paper, he had mentioned that, in order to maintain the utmost efficiency, they must have a high-class man. They must have an engineer who was a competent man to handle an indicator with care, and use his engine properly. He did not intend for a moment by any remarks in the paper to suggest that an indicator should be put into the hands of any and every driver, but only in places where it was necessary to get the last ounce of the power of the combustible out of the engine. He thanked Captain Sankey for his contribution to the discussion. He had shown them that what he (Mr. Tookey) had put before those present was only what science could have done if unaided by practice. To know that, from theoretical considerations and theoretical formulæ, a factor such as that he had presented in the paper could be used in finding out what had always been a difficult

thing to find out—the temperature of the charge—made the discussion very much more valuable than it would have been if Captain Sankey had been unable to be present. Mr. Hawksley had asked why the testing could not be carried out during week-ends. The answer was that 700 week-ends would mean a very considerable period out of one's existence. He thought Mr. Hawksley had misunderstood the reference to the indicator gear. It only meant that the engine was stopped at a time when it would not prejudice the work of the user of the engine. Therefore the dinner-time was utilized, Mr. Chamberlain had suggested the use of the reducing-wheel. That had never commended itself to him (Mr. Tookey) for many reasons. But lately he had been employing a different type of reducing gear which had a pulley gear. As to Mr. Murphy's remarks, the paper was merely intended for illustrative purposes; and in it he had used figures which were only approximate. As to the maximum efficiency and the point of maximum efficiency, it must vary with every engine; but it could be obtained experimentally. It might be interesting to mention here that the factor value did vary with different engines, and at different compression ratios. He thought the use of the factor value by experimenters who had every facility at their command for measuring temperatures and other things to the last ounce, would help very considerably in telling them what maximum efficiency to expect, and also what system of governor was the most reliable and most efficient, taking everything into consideration.

A hearty vote of thanks was accorded to Mr. Tookey.

SPENT PURIFYING MATERIALS AS FERTILIZERS.

Spent gas-purifying materials contain nitrogen in various forms, free sulphur, tar, naphthalene, and volatile acids. Hitherto they have been utilized as manure several weeks before sowing the seed. They are not spread over the surface of the ground, because it has been found that they contain products which are poisonous to culture, prevent germination, or burn the plants. Consequently it is necessary to put them into the soil, so that the noxious substances will be oxidized. The poisonous effects referred to have been attributed to the presence of free sulphur and cyanogen compounds. It has, however, been demonstrated by experiment that sulphur is not injurious to culture; but that, on the contrary, the addition of a little increases the crops. The harmful products are the tar, naphthalene, and acids of the phenol series which are always associated with spent purifying materials.

MM. Bodin and Dupont have lately taken out a French patent (No. 460,745, of 1913) for a process to remove the noxious products alluded to, and thus obtain a fertilizer which does not burn the plants nor prevent germination, and which can be applied in the same way as other manures, though possessing sterilizing and insecticidal properties very beneficial to the microbial flora of the soil. The spent materials are mixed with water to form a paste of uniform consistency, and then dried in a strong current of hot air, at a temperature of about 160° to 180° C. Under the action of heat, humidity, and air, a part of the sulphur is mechanically removed by distillation in presence of steam, the naphthalene is totally distilled, and the volatile acids of the phenol series are carried forward by the steam formed and the current of hot air. There is also a certain oxidation of the iron and ferrous compounds in the materials. There is finally obtained a product containing but little sulphur, and free from the noxious products in question; and it can be used like other nitrogenous manures for seed and for top dressings.

THE "SIMPLICITAS" GAS-CONTROLLER.

Appliances of various kinds for the automatic lighting and extinguishing of public gas-lamps are being used in continually increasing numbers; and the multiplication of sudden decisions on the part of lamplighters to cease work until demands of one sort or another are conceded—as has lately been the case at Leeds—will prove a potent influence in still further popularizing mechanism which will take the place of the man with the torch. Those desirous of adopting them have quite a wide choice of automatic lighters, actuated either by clockwork or by pressure-waves.

One of the latter type is the "Simplicitas," the claims for which are set forth in an illustrated pamphlet issued by the Simplicitas Gas Controller Company, Limited, of No. 42, Old Broad Street, E.C. As is implied by the name, one of the principal of these claims is simplicity; while some others are reliability, strength, and cheapness. The apparatus (in which there is an operating bell, sealed in mercury in the ordinary way) can be fitted either inside or outside the lantern, and in either case, cleaners cannot accidentally displace any working part, everything being enclosed. Adjustment to suit all levels is possible, without any loading; and when it is desired to get at the working parts, all that is necessary is to move a small brass plate. As a matter of fact, there is little to get out of order—no complicated or delicate parts, and only two valves in the apparatus. Unless otherwise instructed, the "Simplicitas" is sent out adjusted to respond to an increase of pressure equal to a 5-10ths rise within thirty seconds; but where it is impossible to obtain such a rise—say, at some extreme limit of the lighting area—the apparatus can be made, by the simple alteration of a lock-nut, to respond to any increase of pressure over 2-10ths, intentionally applied. Accidental rises of pressure, however, will not operate it, even if such rise is equal to an increase of 5-10ths in one minute. The bye-pass flame is extinguished when the main burner is alight; and a special flash pilot ignition arrangement is designed to make failure to ignite impossible, and re-ignition equally certain. In cluster lighting, some of the burners can be turned off, and others left lighted; or an entire cluster can be turned off, and a single burner ignited to replace it. The full main pressure is employed to operate the apparatus.

The "Presto-Simplicitas" form (having fewer parts, and being smaller) is on the same principle, but was designed to meet the cases in which a quick rise of pressure cannot be guaranteed, or "where a lighter is required to operate in conjunction with others of the predetermined pressure type, in such localities as are unworkable with the lighters which are giving satisfaction on other lamps served by the same mains."

NEW YORK WATER SUPPLY.

The Catskill Aqueduct.

It was mentioned in the last number of the "JOURNAL," on the authority of the New York correspondent of "The Times," that the Catskill aqueduct of the New York Water-Works had been partially completed, and was open from the Ashokan reservoir, in the Catskill Mountains, to Flatbush, in New York City. The Engineering Supplement to our contemporary last Wednesday contained a long article on the subject of the water supply of New York; and from it the following particulars in regard to the aqueduct in question have been taken.

The aqueduct is built in open trenches, along embankments, in rock tunnels, through pressure syphons, and steel pipe-lines. In general its cross-section is that of a horseshoe, 17 feet high and 13 ft. 4 in. wide in the clear. On the cut-and-cover portions of the work after completion of the excavation the invert was laid in one operation, and the side walls and arch in another. For this purpose collapsible steel forms of the required shape and size were employed almost exclusively. The aqueduct has a cross-sectional area of 241 square feet, compared with 160 square feet for the New Croton and 52 square feet for the original Croton system.

As the country traversed by the aqueduct from the Ashokan reservoir to the Hudson River was rough, it was necessary to drive a number of tunnels through the rock that was encountered; and two pressure tunnels or syphons were built to carry the aqueduct under the bed of two large streams. It passes under the Hudson River in a syphon consisting of a vertical shaft 14 feet in diameter and about 900 feet deep, a 14-feet circular tunnel upwards of 3000 feet long under the river in solid rock 1100 feet below mean high water, and a second shaft on the opposite side of the river.

Apart from the depth of the shafts, no particular trouble was experienced in constructing the syphon. The work of tunnelling was begun on June 22, 1911, and at the end of the following January the rock wall separating the two tunnels was broken down, so that it was possible to walk dryshod through a hole in solid rock 1100 feet below the surface of the river.

The work between the Hudson and the Croton reservoir had to be carried out in some of the roughest and most difficult country along the line of the entire aqueduct. It includes some 133,000 feet of steel pipe-lines in four lengths, ranging from 600 to 6700 feet, and consisting of 114-inch steel pipe. There was also some cut-and-cover work and some tunnelling on this section. At Croton Lake a pressure tunnel is employed to continue the aqueduct, and a blow-off is provided, so that the water from the aqueduct may be diverted into the lake and carried down to New York if conditions are such as to require water before the aqueduct south of this point is completed.

The Spring Finders.—The following remarks on this subject, by the Paris correspondent of the "Chemical News," appear in the current issue under the heading of "The Scientific Week:" "At the time of the famous experiments undertaken at the second Congress of Experimental Psychology by the spring finders and adepts of the divining rod, M. Armand Viré, Professor at the Natural History Museum, was exceedingly incredulous. However, he became converted, and indeed became a spring finder himself, and, as it were, in spite of himself; and it must be admitted that his conversion caused some astonishment. During the summer months, he invited several spring finders to the grottoes of Padriac, with which he is specially well acquainted, and of which the plans have not been published. There were several negative experiments; but two or three spring finders were remarkably successful. On the surface of the soil they followed several subterranean water springs, and arrived at the points where they left the earth and appeared on the surface. These points were previously unknown by the spring finders. M. Edmond Perrier, when presenting these experiments to the French Academy of Sciences, added that neither he nor M. Viré takes upon himself the responsibility of these observations."

THE DIFFERENCE BETWEEN THE CALCULATED AND DETERMINED CALORIFIC VALUES OF COAL GAS.

By G. WEYMAN, M.Sc.

[A Paper read before the Newcastle Section of the Society of Chemical Industry.]

In the course of the examination of the gas manufactured at the Elswick and Redheugh works of the Newcastle and Gateshead Gas Company, some interesting points were observed. It was noticed that the difference between the calculated and actually determined calorific values was about 28 B.Th.U. per cubic foot for the gas manufactured in the horizontal retort plants; and this difference—provided no great change was made in the method of working—was remarkably constant. When the vertical retort plant was started at Elswick, it was evident that no less than about 43 B.Th.U. would have to be added to the calculated value to bring it up to the determined. When, some months later, a tar circulation was introduced, to keep the cross-collecting mains free from thick tar, the difference between the two values decreased considerably. The tar for the circulation, which at first was taken back to the wells as soon as it entered the large main, was subsequently allowed to run with the gas right along to the condensers. A further decrease in the difference between the two calorific values was noticed. Suspicions as to stripping of the gas by the tar were aroused; and the following experiments were made to solve the point.

A 20 foot holder was filled with gas from the verticals, which was mixed, and allowed to attain a constant temperature. The calorific value was determined and an analysis made. Then gas was passed through a sample of the tar at 16° C., which had been taken from the tar outlet beside the works' condensers, and again examined. From the results shown in Table I. it is evident that the calorific value of the gas had been depreciated by 11·7 B.Th.U. by passing through the tar. The tar has stripped the gas of some hydrocarbons. The calculated calorific value (the constants used are taken from the table in Coste's "Calorific Power of Gases"), however, is practically the same. One would

TABLE I.—*Gas and Tar Separated at 72° C.*

—	Without Tar.	Tar at 16° C.	
Calorific value determined, gross	559·3	547·6	*Note.*—In all the analyses which were made in the Sodeau apparatus the C_nH_m were absorbed in bromine water; the CH_4 and H_2 determined by explosion; and the N_2 by difference. All the calorific values are in gross B.Th.U. per cubic foot.
Calorific value calculated, gross	542·5	543·1	
CO_2	0·0	0·0	
O_2	0·8	0·8	
C_nH_m	2·1	2·2	
CO	8·6	7·8	
CH_4	29·9	29·5	
H_2	53·2	54·7	
N_2	5·4	5·0	
	100·0	100·0	

imagine then that the hydrocarbons removed by the tar are such as are not estimated in the analysis. In fact, the olefines show a slight increase; while the carbon monoxide has suffered to the extent of nearly 1 per cent. The methane and hydrogen also show a change which is more than warranted by experimental error.

A fresh series of experiments was made, in which the tar was heated to different temperatures. It should be noted that the gas and tar were separated in the works at 72° C., and in the results given in Table II., the calorific value at 75° C. is slightly higher than the original sample of gas, while below this temperature it gradually decreases in value.

TABLE II.—*Tar and Gas Separated at 72° C.*

—.	Without Tar.	Tar at 60° C.	Tar at 64° C.	Tar at 70° C.	Tar at 75° C.
Calorific value determined, gross	555·6	542·0	544·5	553·1	558·8

An additional series of experiments gave confirmatory results, which are shown in Table III.

TABLE III.—*Tar and Gas Separated at 72° C.*

—	Without Tar.	Tar at 85° C.	Tar at 85° C.	Tar at 92° C.	Tar at 86° C.	Tar at 75° C.	Tar at 60° C.
Calorific value determined, gross	543·6	549·6	551·1	554·7	555·2	548·0	535·5
Calorific value calculated, gross	545·7			544·4			
CO_2	0·0			0·0			
O_2	0·4			0·3			
C_nH_m	2·4			2·4			
CO	9·1			8·8			
CH_4	29·4			29·2			
H_2	53·1			53·6			
N_2	5·6			5·7			
	100·0			100·0			

In this series the tar was gradually heated and then slowly cooled; the calorific value and samples for analysis being taken at intervals. The calculated value for the original gas is higher than the determined, but falls below as the temperature at which it passes through the tar is raised above 70° C. Considering these results as a whole, it is quite clear that there are present in the gas some hydrocarbon vapours which are not estimated in the analysis, and therefore, while they contribute towards the determined calorific value, are not included in the calculated figure. These hydrocarbon vapours, unlike the hydrocarbons estimated by bromine, are easily removed by tar—in fact, a state of equilibrium exists between tar, gas, and hydrocarbon vapour, which depends on the temperature at which they are in contact. The higher the temperature, the greater will be the amount of vapour in the gas; and if the gas is then removed, it will, of course, carry the vapour with it. Also it is evidently these vapours which make the difference between the calculated and the determined values, rather than any difference in composition of the olefines determined by absorption in bromine water.

The variation in the difference between the calculated and determined values shown in connection with the vertical plant is clearly due to the lower temperature of separation of tar and gas when the tar circulation was introduced, with consequent reduction in the amount of hydrocarbon vapour present.

These considerations led me to find a way of estimating these hydrocarbon vapours; and I soon found that Bunsen had distinguished between the permanent unsaturated gases, ethylene, propylene, &c. (the olefines), and the vapours of volatile saturated hydrocarbons. Bunsen found that the vapours could be dissolved out in absolute alcohol; while the excess of alcoholic vapour could be afterwards removed by water. The estimation must be made before any treatment of the gas, since benzene and other vapours are soluble in caustic soda, cuprous chloride, and other reagents. It is necessary to have the oxygen expelled from alcohol and water by saturation with coal gas.

In order to find out exactly what difference the prior removal of the hydrocarbon vapours would make, I analyzed a sample of gas with and without removing them. The result is given below:

TABLE IV.

—	Ordinary Method.	Bunsen Method.
Hydrocarbon vapours	—	2·0
CO_2	1·0	0·7
O_2	0·8	0·7
C_nH_m	3·3	2·4
CO	8·0	7·0
CH_4	34·8	31·9
H_2	47·2	48·6
N_2	5·9	6·7
Calorific value determined, gross	618·6	618·6
Calorific value calculated, gross	597·6	624·2

Note.—Hydrocarbon vapour assumed to have a calculated value of 3738 B.Th.U. per cubic foot; C_nH_m, 2301 B.Th.U. per cubic foot.

The result is interesting as showing that the 2 per cent. of hydrocarbon vapours, unless previously removed, contributes to the amount of gas absorbed in the various reagents and is left in sufficient quantity to affect materially the determination of the methane and hydrogen. The olefines show a decrease of 1 per cent., which is partly to be attributed to the bromine removing some of the vapour (while the caustic soda used to remove the excess of bromine vapour adds to the effect), and also to some absorption of ethylene in the alcohol. The carbon monoxide is affected to a similar extent. The vapour which has survived the absorbents in the first case is much richer in carbon than methane, and this throws the calculation of the hydrogen out.

The apparent discrepancies shown in the analysis of gas passed through tar described above are evidently the result of varying amounts of the hydrocarbon vapours. So that, instead of carbon monoxide being apparently dissolved by passing gas through tar, it is merely due to abstraction of hydrocarbon vapour by the tar. A paper published in the "Journal of the American Chemical Society" for 1908 by Dennis and M'Carthy recommends the use of an ammoniacal solution of nickel cyanide for estimating benzene in coal gas. The solution, however, has to be used after the absorption by caustic soda, leaving the latter free to absorb any hydrocarbon vapours. The solution also does not absorb homologues of benzene.

It seems a great pity that modern authors have apparently overlooked the presence of these vapours. In fact, in one book published in 1911 dealing with the subject, benzene is found classed with the unsaturated hydrocarbons, and assumed to be absorbed by bromine. Benzene, of course, is a saturated compound (the aromatic compounds corresponding to ethylene and acetylene are cinnamene and phenyl-acetylene) which is only very slightly attacked by bromine under specific conditions. Moreover, there is (as Bunsen and others have pointed out) a great physical distinction between the hydrocarbon vapours and the permanent gases, ethylene, propylene, &c., and for this reason it is desirable

to estimate them separately. The gas manager, for example, need not trouble about the olefines once they are formed; but the utmost care must be taken if the hydrocarbon vapours are not to be lost in the purification. On the other hand, it is difficult to see how a correct gas analysis can be made unless these vapours are removed beforehand.

In order to complete the investigation, a similar series of experiments to those described above were made, except that the hydrocarbon vapours were separated by means of alcohol in the analysis. The results are given in Table V. and need little explanation, though it might be remarked that the gas passed through tar at 60° C. has a greater calorific value than the original gas, which was not so in the former case till the tar reached a temperature of over 70° C. This is, of course, because the tar and gas were separated in the works at a lower temperature in the latter case.

TABLE V.—*Tar and Gas Separated at 52° C.*

	Without Tar.	Tar at 15° C.	Tar at 60° C.
Calorific value determined, gross	532·3	523·3	542·2
Hydrocarbon vapours	1·3	0·5	1·6
CO_2	0·1	0·1	0·1
O_2	0·2	0·2	0·2
C_nH_m	2·4	2·4	2·4

SUMMARY.

It has been shown above that serious errors may be introduced into an analysis of coal gas if the hydrocarbon vapours are not first removed. Alcohol may be used for this purpose, and distinction is then made between these vapours and the olefine gases subsequently absorbed by bromine. A small amount of ethylene is absorbed by the alcohol. Unless an allowance is made for these vapours, of which the chief constituent is benzene, the calculated calorific value is likely to differ very considerably from the determined value. Although insufficient data are at present to hand regarding the calorific power of the vapours absorbed by alcohol, yet, seeing that they consist largely of benzene, the constant will approach that of benzene. It is also evident that the value taken for the olefines—2301 B.Th.U. per cubic foot (or even higher)—and which has been used to cover the calorific value of the hydrocarbon vapours which have not usually been estimated, will be too high.

In this connection, the work of Lebeau and Damiens, who found in the Paris gas about 2 per cent. of ethylene and only about ½ per cent. of propylene, is of interest as indicating that the calorific value of the gases absorbed by bromine is more likely to approach that of the former than the latter. Variation in the amount of hydrocarbon vapour present in different gases is more likely to occur than the large variations in the composition of the olefines which has often been assumed to account for discrepancies between calculated and determined values.

It has been again pointed out that the hydrocarbon vapours form a class of substances distinct from the olefine gases; and these vapours are responsible for an appreciable item in the total calorific value. To ensure these vapours being present in as large an amount as possible, the gas should be removed from the tar as hot as other factors will allow, since there is an equilibrium between tar, gas, and vapour, depending on the temperature (provided other conditions are similar) at which they are in contact. It is not likely that sufficient vapour will be obtained under ordinary carbonizing conditions to saturate the gas at the ordinary atmospheric temperature; and if it be so, the liquid condensed on cooling would prove a useful solvent for any solid naphthalene which may be deposited.

SCOTTISH JUNIOR GAS ASSOCIATION.

EASTERN DISTRICT.

Visit to Messrs. J. G. Stein and Co.'s Works.

Highly interesting and instructive was the visit paid on Saturday afternoon by members of the Scottish Junior Gas Association (Eastern District) to the Castlecary works of the well-known firm of fire-brick makers, Messrs. J. G. Stein and Co., Limited. The Company have three works, these being situated at Bonnybridge, Denny, and Castlecary. The last-named are the most important of the three. The visitors arrived at the newly-built handsome offices of the firm shortly before three o'clock; and there, in order that they might have the best opportunity for a thorough inspection of the works, the company was divided into small parties, each of which made a tour of various departments under an efficient guide.

The party under the guidance of Mr. Allan Stein, son of Mr. J. G. Stein, the principal of the firm, commenced their inspection by examining some samples of clay. At this initial stage what are perhaps two popular delusions in regard to clay, held by those who have no practical knowledge of it, were, so to speak, exploded. The clay taken from the mine is not soft and plastic. It is quite hard, and has to be blasted. It is not, either, of yellowish colour. It is of a dark greyish hue, and only changes into the colour of a brick after it has been fired in the kilns. From these samples, the party proceeded to the pit-head, and made an examination of the winding engine, and a compressed air engine for hammer drills. Mr. Stein stated that the clay on being brought from the mine to the pit-head, is sent to the breaker, which reduces it to fair sized pieces. Thereafter it goes down a shoot to a grinding mill, which is capable of dealing with 250 tons of material a day. The breaker does a fair part of the work of reducing the clay.

After the clay has been ground to dust, it falls through a grating beneath the mill, and is thereafter conveyed by means of an elevator to a loft, where a stock of it is kept. There is also another mill at the works for grinding fire clay. The party examined the mill where the clay dust is mixed with water to the right consistency. Broken bricks, to a certain percentage, are put through the mill and mixed with the clay, for the purpose of stiffening the bricks which are to be made. The dampened clay is afterwards sent along in bogeys to the brick moulders, who work in a room about 1000 feet in length and 110 feet in width. The floor space in this department of the works is valuable; and in order to save it the bogeys of clay are sent along overhead, and their contents passed down a shoot to the particular worker who requires the clay. The party had an opportunity of witnessing the moulding of bricks both by hand and by machine; one special form of brick which was being moulded being for Woodall-Duckham vertical retorts. The machine which was making these bricks is capable of turning out some 5000 a day. When the bricks are shaped, either by machine or hand, they are placed on the floor, which is steam heated, and are allowed to lie there for two or three days, until they become thoroughly dry. Then they are taken to the kilns to be burned. For the firing of bricks, there are two different classes of kilns at the works. One class is the Newcastle kiln, and the other is a series of 53 ovens which are divided into four "zones." The fire travels along the zones; and while one oven is firing the "green" bricks, ovens behind it which have already been fired are being emptied. The fire goes on a chamber a day, and a chamber a day is emptied. The bricks lie in the kilns about a fortnight. Adjacent is a railway line along which the waggons for conveying the bricks travel; and the bricks are transferred conveniently from the kilns to the waggons.

Perhaps to the visitors the most interesting portion of the works was the department in which gas-retorts were made. A number of these in various stages were seen, and a worker explained the process. The retorts are constructed a portion at a time, each piece being about 3 feet in height. When one portion has been made it is thoroughly dried, the bottom of a "drum" is fitted into the top of it, and the next piece built round the "drum." This fresh portion in turn is allowed to dry, and then the next section is similarly built. [Mr. Allan Stein suggested that it would be a help to the retort makers if the gas managers had a standard retort.] The retort, when built and dried, is conveyed to the kiln, where it is duly fired.

At the conclusion of the inspection, the various parties gathered in one of the rooms in the office, where tea was served. Mr. J. G, Stein presided.

The CHAIRMAN, in welcoming the visitors, stated that they were the first Gas Association who had paid them a visit, though they had had several gas managers there. He hoped that they would have both official and unofficial visits in the future, to their mutual advantage and pleasure.

The PRESIDENT (Mr. W. Geddes) said that, on behalf of those who were present, it was his privilege to convey to Mr. Stein, to Mr. Stein, jun., and to the other members of the staff and the employees who had so kindly devoted their afternoon to the visitors, their warmest appreciation of the trouble that had been taken in showing them over the works. He also thanked the firm for the hospitality shown. The visit had been a great pleasure, because if there was one part of the plant more important than the other it was the settings and retorts.

Mr. HENRY O'CONNOR also thanked those who had shown the parties round the works. The making of fire-bricks and of retorts they were, he said, almost being told some time back was only understood in Germany, and that the only good material to be obtained came from that country. He thought they had seen that day how these articles could be made from native material—and made not only satisfactorily, but in very good order indeed. The temperatures used in retort-settings nowadays were different from what they were a few years back; and fire-bricks and retorts had to stand these higher temperatures. They had had evidence that day that the firm had been taking advantage of every recent advance in the brick-making world to turn out the material that was required; and the opportunity that they had given the visitors to look round the works, and see exactly how all these different bricks of various shapes and kinds were made, both by hand and machinery, and how the retorts themselves were manufactured, formed a lesson that they could take away with them.

Natural Gas in Hungary.—At the beginning of the present month, the time expired, according to the "Chemical Trades Journal," when the financial institutions concerned with the scheme for the utilization of natural gas in Hungary had to give a definite intimation in regard to the proposed formation of a special company for carrying out the project. This has, however, not taken place; and the "Frankfurter Zeitung" states that it is asserted that the English group which was to have participated in this financially important transaction withdrew at the last moment because the reports prepared by American and English experts were not sufficiently promising for the purpose. The Hungarian banking group has now asked for an extension of time, so as to take up a definite position in the matter; and the option has been prolonged by the Ministry of Finance until April 1.

SOLUBILITY OF CARBONATE OF LIME, AND ITS BEARING ON TREATMENT OF WATER SUPPLIES.

By WILLIAM T. BURGESS, F.I.C.

[Abstract of a Paper before the Institution of Water Engineers.]

The majority of water engineers have to deal with more or less calcareous supplies, and there are two groups in particular who have to practically study the matter. On the one hand many are in charge of works where the supplies are softened—the operation being mainly the removal of carbonate of lime; on the other hand, there is another group concerned in hardening their soft supplies, usually by adding carbonate of lime, with the object of neutralizing acidity, and preventing possible action on lead.

Carbonic acid is the natural agent which accounts for carbonate of lime in water supplies; but it is incorrect to assume that the rain water which falls on calcareous areas carries sufficient carbonic acid to effect the solution. Rain water seldom contains more than 1 part of carbonic acid per 100,000—a proportion quite insignificant towards effecting the solution of such amounts as are found in chalk-derived waters. A much larger quantity of carbonic acid comes from the decomposition and oxidation of the organic matters in the soil on which the rain falls. Water saturated with carbonic acid at ordinary pressure and temperature will take up as much as 100 parts of carbonate per 100,000 of water; but nothing like this amount is ever found in public water supplies. From numerous analyses the author has made it appear that the proportion of carbonate of lime in calcareous waters is seldom over 30 parts per 100,000. Carbonate of magnesia is much more soluble than carbonate of lime, both in pure water and in water saturated, or partly saturated, with carbonic acid. The elimination of the carbonic acid, which is loosely combined with the carbonate to form bi-carbonate, will cause the separation of the carbonate of lime. After long storage, calcareous waters tend to lose carbonic acid, particularly in open reservoirs where vegetation flourishes.

Many chemical substances may be added to water to combine with the carbonic acid, and thus induce the precipitation of the carbonate; but of all these lime is the cheapest and best.

Referring to the removal of carbonate of lime from water by Clark's lime process, the author said: As is well known, the hard water is mixed with a proportion of lime-water just sufficient to react with the carbonic acid which holds the carbonate of lime in solution; the carbonate originally present, together with that formed by the combination of the carbonic acid and lime, becomes insoluble, and falls out as a fine crystalline precipitate—leaving the water softened. This general statement requires a little qualification; for carbonate of lime has a slight degree of solubility in water entirely free from carbonic acid, the amount being 1·5 parts per 100,000. From this it follows that it is impossible to reduce the carbonate of lime hardness in the most favourable water below that figure, at any rate, by any simple lime process. The carbonate of lime is either allowed to settle down in large subsidence tanks, or, after giving a short time for the reaction, it is filtered off.

Considering, first of all, the method of subsidence in tanks, it is a matter of common observation that the time taken before the water clears is by no means constant. Sometimes the water is bright in six or seven hours, while at other times twelve to fourteen hours elapse before the precipitated carbonate has properly subsided. The reason for this variation, where the conditions are apparently identical, is obscure, but it probably depends on the way in which the lime water and hard water happen to mix, intimate mixture and good agitation favouring the formation of a fine precipitate. Although twelve to fourteen hours are usually sufficient for subsidence and the production of brilliant water, there is a great advantage in allowing many hours more, for the water, although clear, is often in the condition of a super-saturated solution of carbonate of lime; and from such a solution the excess carbonate, while it does not form a further precipitate, will crystallize out slowly on the sides of the tanks, or, if sent out too soon, in the mains. One of the objects of this communication is to call attention to the fact that the full separation of the carbonate is often a matter which requires a much longer time than is usually supposed.

The subject is best illustrated by the results of a few laboratory experiments. In the tests the waters were treated with the proper proportions of lime-water to effect good softening, and after the precipitate had subsided, the perfectly clear top was carefully syphoned off at intervals and examined for total carbonate in solution.

A.—*Chalk-Derived Water.*

[Total carbonate hardness in untreated water, 22·5 parts per 100,000.]

	Total Carbonate found in Clear Water after Softening.			
Time of subsidence—hours	10	25	49	73
Total carbonate in clear softened water in parts per 100,000	4·8	3·9	3·6	3·6

B.—*Calcareous Water.*

[Total carbonate hardness in untreated water, 17·6 parts per 100,000.]

	Total Carbonate found in Clear Water after Softening.			
Time of subsidence—hours	10	22	46	70
Total carbonate in clear softened water, in parts per 100,000	3·1	2·8	2·4	2·1

C.—*Chalk-Derived Water.*

[Total carbonate hardness in untreated water, 22·4 parts per 100,000.]

	Total Carbonate found in Clear Water after Softening.				
Time of subsidence—hours	12	24	36	60	84
Total carbonate in clear softened water, in parts per 100,000	3·7	3·3	3·2	3·0	3·0

A consideration of the above results is quite sufficient to show that, even when perfectly clear water is drawn off and pumped to distribution, there is more than a probability of the crystallization or separation of a small amount of carbonate of lime in the mains. The longer the time the water is stored before distribution, the less the probability of deposit.

The author has made many experiments to ascertain the effect of partial softening in the delayed separation of the carbonate. In the tests recorded below, the waters were treated with the correct proportion of lime-water (A), and also with smaller proportions to effect less softening (B, C, and D).

Calcareous Water.

[Total carbonate hardness in untreated water, 17·2 parts per 100,000.]

Time of Subsidence.	Total Carbonate Found in Clear Softened Water, in Parts per 100,000.			
	A	B	C	D
10 hours	3·3	3·8	4·1	5·8
22 ,,	3·0	3·6	4·0	5·8
34 ,,	2·6	3·3	3·7	5·7
46 ,,	2·5	3·1	3·6	5·6
70 ,,	2·3	3·0	3·5	5·5
94 ,,	2·1	2·9	3·4	5·4
Total carbonate which separated out *after* the water had first cleared	1·2	0·9	0·7	0·4

Chalk-Derived Water.

[Total carbonate hardness in untreated water, 20·1 parts per 100,000.]

Time of Subsidence.	Total Carbonate found in Clear Softened Water, in Parts per 100,000.			
	A	B	C	D
11 hours	3·4	4·2	5·8	7·2
23 ,,	3·2	4·0	5·6	7·2
47 ,,	3·1	3·8	5·4	7·1
71 ,,	2·9	3·7	5·4	7·1
Total carbonate which separated out *after* the water had first cleared	0·5	0·5	0·4	0·1

Only one conclusion can be drawn from these figures, and that is, the more perfectly the water is softened, the greater is the necessity for giving it a long period for subsidence; and it is the irony of fate that at works where the most efficient softening is aimed at, the probability of deposition of carbonate in the mains is greater than at places where partial softening is the rule.

With regard to softening-works where filtration is relied on for the removal of the carbonate, the question arises, Is such filtered water more or less liable to form an after-deposition of carbonate than the clear water obtained from subsidence water? In the author's opinion the liability is certainly not greater.

At what may be termed filtration-works the hard water and lime water are intimately mixed in their proper proportions at once; this favours the formation of a very fine precipitate, a large portion of which remains suspended in the water during the short time—usually about one hour—until the turbid water reaches the filtering cloths where the precipitate is arrested. The surfaces and pores of the cloths soon become coated with the fine crystalline precipitate, and in making its way through what is practically a porous surface of carbonate of lime crystals, the water tends to part with any excess carbonate which it really holds in solution. This action compensates for the shorter time taken in the filtration process, and thus places the clear products of the two systems nearly level with regard to their liability to form deposits in mains and pipes.

After all, it may be argued that at well-conducted works not much trouble arises from deposition in the mains; but the author desires to point out that it may be practically prevented by simple chemical means. The addition of a small amount of acid to the treated water from either subsidence or filtration works will entirely prevent the after-separation of the carbonate; and carbonic acid is probably the cheapest and easiest applied. In this connection members may be reminded that, in the rapid softening process of Archbutt and Deeley, in order to prevent the after-separation of carbonates from the treated water, the water leaving the softening-tanks is "carbonated" by the introduction of air charged with carbonic acid drawn from the chimney of a coke-stove. The author has reasons for thinking that the application of such "carbonating" at ordinary softening works would often be useful to engineers. The introduction of only a very small proportion of carbonic acid, even as little as 0·3 part per 100,000, is sufficient to check, or stop, the after-deposition of carbonate. In

carrying out any experiments, it would be necessary to proceed with caution, because the introduction of too much carbonic acid might lead to other troubles; but the author believes that the complete control of carbonating plant would not be difficult.

The amount of carbonate of lime that a soft moorland water is capable of taking into solution is strictly limited, and is governed by the degree of acidity, which can, of course, be determined by analysis. Moorland waters always contain some free carbonic acid, and often, in addition, other acid or acids. If the free acid is simply carbonic acid, any proportion less than 0·7 part per 100,000 will only affect the solution of 1·5 parts of carbonate of lime—the same proportion as pure water will take up. With greater amounts of carbonic acid the proportion capable of passing into solution is exactly that which corresponds to the possible formation of bi-carbonate. Thus a soft water containing 1 part of carbonic acid will dissolve 2·4 parts of carbonate of lime. When the water contains, in addition, another free acid, this will determine the solution of a certain amount of carbonate, and liberate a corresponding quantity of carbonic acid, which will take up a further proportion in the form of bi-carbonate. Knowing the amount of acidity in the water, the chemist can therefore calculate the maximum proportion of carbonate which is possible of solution.

The carbonate is usually applied to soft waters in the form of powdered chalk, or whitening; and if the question of cost could be neglected, theory suggests that the material should be in the finest possible state of division. The fine particles expose a great surface to the water, and have the advantage of remaining in suspension for a long time.

Dr. Houston, in the eighth research report to the Metropolitan Water Board, gave an account of experiments demonstrating the sterilization of raw Thames water by treating it with lime considerably in excess of that necessary to effect softening alone. The treatment of soft waters was also dealt with; and in the ninth report (April, 1913) this matter is followed up, and notes are given showing the practical sterilization of a "very soft, peaty river water" by small quantities of lime. Experiments are quoted, indicating that purposely polluted water could be brought to a reasonable standard of bacteriological purity by the germicidal action of 2 parts, or even 1 part, of lime per 100,000 parts of water; the former proportion being effective in 48 hours and the latter in 144 hours. With regard to the free lime left in the water, Dr. Houston states that, if thought desirable, it could be removed by the addition of bi-carbonate of soda. Dr. Houston recognizes that there would be cheaper methods of neutralizing the excess lime, "although none perhaps so apparently free from any disadvantages." The expense of the suggested treatment will be better understood when it is explained that any free lime left in solution will require exactly three times its weight of bi-carbonate of soda to neutralize it; and as this substance costs about £6 a ton, or roughly six times as much as lime, it follows that the expense of neutralizing will be eighteen times the cost of the free lime left in the water after sterilization.

DISCUSSION.

The PRESIDENT (Mr. C. Clemesha Smith) remarked that the paper was very interesting to those members who had to deal with the softening or the hardening of water. It was an advantage to the Institution to have among the members men who looked at these various problems from other points of view—the chemical and the bacteriological—than those of the engineer. He noticed in one part of the paper the author suggested the introduction of a small amount of carbonic acid to check, or stop, the after-deposit of carbonate. Was there not the possibility, by adopting this treatment, that they might render the water acid to such an extent as to cause it to act upon lead? With reference to the application of carbonate of lime to soft waters, Mr. Burgess suggested that the particles should be in the finest state of subdivision. His (the President's) own experience confirmed this. He had used ground chalk in various degrees of fineness. They found, however, that the finest state of subdivision was the more costly. Deposited carbonate of lime was in a finer state of subdivision than any of the ground chalks.

Dr. S. WOLFF (Manchester) remarked that having to deal with softened waters nearly every day, he had had a good opportunity of studying the effect of the carbonation on waters. The difficulties encountered by the addition of carbonic acid to the water could be minimized if proper precautions were taken. There was a simple test to prove whether an excess of carbonic acid had been added. He used phenolphthalein, which, if the water had been softened, gave to it a different colour; and, where carbonation had taken place, some different colour would be obtained. Where an excess of carbonic acid was added, it was very harmful—especially by setting up corrosion of iron pipes. He thought on this subject it would be of interest to bring forward the result of some investigations he carried out some time ago on the hardness of rain water, and which he included in a paper read before the Society of Chemical Industry, on the effect of atmospheric conditions on the hardness of rain water. They had been puzzled by the fact that, after a water had been softened and contained 3½° to 4° of temporary hardness, it still formed a large amount of scale in pipes and boilers. He had an opportunity of making some interesting observations about that time on surface rain water; and he found that the cause of the hardness of the reservoir water was due to the rain water picking up matters from the atmosphere. In a case where he was called in to investigate the question of scale in boilers, where softened water was employed he asked whether any rain water was used. The reply was that they added about half the volume of rain water before it entered the boilers; and he found the mixed water had 12° of hardness. He thought this had a great bearing on the matter, and so they should go a little farther than carbonate of lime in troubles of this kind. On more than one occasion, he had had the satisfaction of getting these results confirmed. Since he investigated the matter, the people concerned had kept off all supplies of rain water, and no more trouble had arisen. He had found temporary hardness in rain water, permanent hardness, and even magnesia hardness.

Mr. F. W. HODSON (Loughborough) claimed to have had considerable experience of the softening and of the carbonating of water. The author dealt largely with the question of the carbonate of lime in water; but he (Mr. Hodson) did not think he had given sufficient prominence to the main factor, which was that the presence of carbonate of magnesia along with carbonate of lime made all the difference. Mr. Burgess suggested that they could get water right in six or seven to twelve or fourteen hours; but he did not go on to say that there were waters which would take fourteen days. He commented on the fact that the first tables in the paper show results of water softened with the proper proportion of lime water, but he should have tested to have seen variations on each side of the proper proportion, because, in practical work, one always did get a little variation. The excess side especially was important. A further precipitation of 1·2 parts per 100,000 might seem small on paper; but he found it was a question of 3 inches in the reservoir at the end of twelve months. One reason why he should have liked to have seen the results of subsidence where an excess of lime had been added would have been to know whether any beneficial effect followed from putting in an excess of lime with the idea of more quickly getting out the carbonic acid and completing the reaction, when, by putting in the exact amount, one hoped to absorb just the quantity that was there. He knew if the water contained magnesia, then the question of putting in an excess could not be taken in hand, because it left the lime in a peculiar condition, and it took a large number of hours to settle out. Mr. Burgess expressed the opinion that simple subsidence and filtration through cloth came to pretty much the same thing in the end. Put in other words, this meant that no system was quite satisfactory, because he thought there were few cases where some trouble, more or less, had occurred in mains and reservoirs where a softening process was in use. The trouble might be small in the early years, when one did not notice it. But there was a gradual increase in the coating of the mains with a hard scale, which became of great importance in connection with pumping-mains. There was no doubt that the agitation by the pump immediately after softening had an effect on the water, so that one had a deposit on the mains immediately after passing the pumps, and to a less extent as the mains got farther off and nearer to the reservoirs. In regard to carbonating, one found it was a great difficulty, but he was sorry to say it was not a perfect cure. It took large quantities of carbonic acid *plus* air. There was, as Mr. Burgess pointed out, the possibility of other troubles by the use of carbonic acid. One found that carbonic acid which had been put into the water, even after the lapse of a number of hours in a tank, after it had been carbonated, and before it came to the pumps, had a tendency to come out of the water again by the reduction of the pressure on the suction side. It had a very detrimental effect on the valves of the pumps when passing through at a high velocity.

Mr. C. H. ROBERTS (Aberdeen) fully agreed with the previous speaker in what he said regarding the sedimentation of lime in suspension in the water. In the paper, the author gave a reason for the variation in time which water took to clear itself. Mr. Hodson had referred to other constituents in the water affecting the question. He (Mr. Roberts) believed it had been found by experiment that in the case of waters which gave trouble in regard to the lime going down, if pre-filtration was resorted to, the difficulty disappeared. The author advocated the addition of carbonic acid to water treated with lime, to bring about carbonation in tanks rather than in the mains afterwards. He himself had seen two works where carbonic acid was being added to the water continuously for the purpose advocated by Mr. Burgess. He had seen it added at Swadlincote and at St. Helens. He believed it was also added at Stockport and at water-works in Cornwall; but he was not sure whether the carbonic acid was added with satisfactory results. Certainly at St. Helens he was told that since carbonic acid was added, they had had no trouble from excessive carbonate of lime in the mains, and that they had had no trouble with regard to any excess of carbonic acid acting on the pipes. At Southampton and other places where carbonic acid was not added afterwards, there was some carbonation in the mains. It had to be remembered that, by putting carbonic acid in the softening plant, part of the softening advantage was lost, because the hardness was increased again. It should also be remembered that carbonic acid was an acid; and he believed that in Germany, in experimental work, there had been experienced a good deal of trouble due to the action on the pipes. He understood that they had had trouble not only with cast-iron pipes, but in concrete reservoirs. In Aberdeen, they had tried the excess lime process on a practical scale; and they found satisfactory results from the experiment. It was true they did not attempt to carbonate the excess of lime either by carbonate of soda or carbonic acid, but

they found something which was very interesting—that, in the progress of the water through the aqueduct and reservoirs, the excess lime tended to be carbonated by contact with the atmosphere in its passage. It was, he thought, beyond doubt that, if the water was subjected to contact with the air, after being dealt with by an excess of lime, the small amount of carbonic acid in the air would have the effect of carbonating the small amount of free lime there might be in the water. They found this was so in Aberdeen, and that there was a decided reduction. The lime process seemed to be raising an enormous amount of interest in the North and in Scotland, where the waters were generally soft. Edinburgh was considering very seriously the question of adopting the excess lime process to purify the water.

Mr. H. PRESTON (Grantham) remarked that he had found that water which had percolated the limestone in Lincolnshire, as it passed from west to east, took up a little soda from the rocks, and that the soda precipitated the carbonate of lime. He asked whether the author thought that there would be a natural precipitation of the carbonate of lime as the water travelled along the rocks.

Mr. BURGESS, replying to the discussion, remarked that troubles likely to be caused by the carbonic acid had been hinted at by several of the speakers. He had particularly referred in the paper to the possibility of getting too much carbonic acid in; and thereby getting some action upon iron. If there was any method of using the carbonic acid in regulated quantity, any chance of trouble should be reduced to a minimum. He did not quite follow what the President said as to the fine state of subdivision of the various kinds of carbonate he used. Did he understand that the precipitate from the softening works was found to be finer than the ground chalk? [The PRESIDENT: Yes.] In his opinion, ordinary whitening was much finer than the precipitated carbonate they got from the softening works. He had read Dr. Wolff's paper on rain water. In the South of England, rain water collected in proper receptacles contained very little of anything that was likely to cause hardness. He had, however, come across some extraordinary stuff that was sent to him as rain water. In one case, some samples were forwarded of rain water taken from new cement tanks, and this water had taken up a large amount of carbonate from the cement itself. Commenting on Mr. Hodson's remarks, Mr. Burgess said, among other points, that a considerable number of calcareous waters in the South of England were softened in which magnesia hardly entered into consideration. Mr. Roberts had referred to the neutralization by air of the free lime left after excess lime treatment. The only information he (Mr. Burgess) had on this subject was taken from Dr. Watt, who gave some figures with regard to the amount of carbonating that took place through the atmosphere in the passage of the water from works to city. In this case, they aimed at putting in 3 parts of lime per 100,000. The water contained 2·7 parts per 100,000 leaving the works. When it reached another service reservoir, it still contained 1·27: and, after passing the reservoir into the mains, there was no possibility of any more carbonic acid getting to the water. Mr. Preston's question would be very difficult to answer without having a good talk with him.

Birmingham Water Supply Proposals.

Some time ago, the Birmingham Water Committee brought forward proposals which it was anticipated would ultimately result in the laying of a third pipe from Wales, which would entail a big addition to the already heavy financial burden of the undertaking. It has now, however, says the "Birmingham Mail," been suggested to the Committee that the laying of this third pipe might be obviated by the introduction of centrifugal pumping engines at various points on the route, and that these engines could be made to accelerate the flow of water along the pipes, and so increase the supply by something like 50 per cent., without any further facilities being provided. The theory has been advanced, it is stated, by Mr. Thomas Reid, of the Municipal Technical School, and is said to have been adopted in Australia and in the United States in connection with schemes for carrying water long distances. The normal rate of flow in the Birmingham mains from Wales is, the paper adds, about 2·4 feet per minute—a flow which is purely due to gravitation. The plan advocated by Mr. Reid, it is claimed, would accelerate this flow to the rate of 3¾ or 4 feet per minute; and it is said that in America, by the system referred to, a flow of 6 feet per minute is attained. Moreover, it is urged that, as the centrifugal pump applied to this purpose would operate rather by suction than by compression, the pressure of water on the pipes would not be increased.

Derbyshire Water Supply.—Need for additional water storage capacity, in relation to two important Derbyshire areas, was indicated at the last meeting of the Ilkeston and Heanor Water Board, when the Engineer (Mr. A. E. Smith) explained that the reservoir at Chadwick Nick held two days' supply, and he thought it would be a great advantage to have a reservoir nearer home, presumably at Marlpool, which would supply both Heanor and Ilkeston. Upon the question as to probable cost, he pointed out that the Chadwick Nick reservoir for 1½ million gallons cost £8000, but since it was built the cost of materials had gone up by some 25 per cent. The Mayor of Ilkeston (Mr. J. A. Macdonald) emphasized the serious importance of the situation as far as it affected the borough. The question of a new reservoir had been agitating the Ilkeston authorities for some time, as practically speaking they had only one day's supply. He thought Mr. Smith's suggestion was a good one, especially if Heanor was in the same predicament as Ilkeston. The Engineer was requested to bring the matter under consideration again after certain preliminary action had been taken.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Coal Exports and Home Prices.

SIR,—You commence your very interesting editorial paragraph entitled "Coal Exports and Home Prices" by saying that—

> "if Mr. Charles Carpenter, D.Sc., in his controversy some little time back with a representative of the colliery interests, had had before him the returns relating to the foreign trade of this country in 1913, he would have had an exceedingly easy task in demonstrating the tremendous penalizing influence that the export of coal from this country has upon British people and industries using the native coal."

And I have naturally perused the remainder of the paragraph in order to discover how the knowledge of the figures of 1913 could a year ago have transformed into "an exceedingly easy task" what was then an impossible one. You will remember that the proposition put to Mr. Carpenter was that

> "it would be an unfair thing if taxation were made a lever to depress one British industry for the benefit of another British industry."

And I would like you to explain to your readers how the knowledge possessed to-day that the exports of British coal amounted in 1913 to some 9 millions of tons more than in 1912 can be a justification for doing an unfair thing.

I exceedingly regret that Mr. Carpenter was not fully accoutred a year ago; but I doubt whether the weapon which you have handed to him with the suggestion contained in your paragraph, that he should use it to get the Chancellor of the Exchequer to tax the export of coal, is one which will prove any more serviceable than those of his armoury of a year ago. Export of coal will naturally grow, just as home trade grows, and just as production grows when circumstances are favourable. But the knowledge of the figures from year to year cannot make it fair for a Government, which is charged with the care of national interests, to intervene for the purpose of favouring one industry as against another.

I have always agreed with Mr. Carpenter that, if the export of coal were prevented or impeded, it would greatly benefit the gas companies in this country; and if collieries were forced by legislation to seek only home markets for the coals they produce, then the gas companies would be able to fix prices not only "partly arbitrary" as you put it, but entirely arbitrary. The coal fitter would then be ground between the upper and the nether millstones, and gas companies would for a time have cheap coal, until the production became reduced by collieries being closed-down owing to unremunerative prices. Then, when the production was curtailed to the extent of the home demand, prices would again rise to their true level.

No business man will object to gas companies trying in every legitimate way to reduce coal prices; but to seek by Government interference to upset all the industries which depend upon the production and transport of coal foreignwise would surely be acting like the Chinaman who burnt down his house in order that he might eat roast pork.

Newcastle-upon-Tyne, Jan. 15, 1914. COAL FITTER.

[We will not insult the intelligence of our readers by explaining to them how an increase in a year of 9 million tons in the coal exported from this country would assist in enabling colliery owners to maintain prices as against home consumers. Our correspondent's limitations in viewing the question of fairness are obvious; but we will do him the credit of believing that these limitations are only assumed for the purpose of supporting his argument. In his writings, he considers the question from the single point of view of the coal-owners; we from the national point of view. The native coal is an heritage of the people of this country; and if its export for use in other countries contributes (as it undoubtedly does) to the maintenance of such high prices as at present rule to the detriment of home industries and consumers generally, then (without there is some national compensation) it is an unfair thing, of which no amount of subtle argument, prompted by personal interest, can dispose.—ED. J.G.L.]

Church Lighting.

SIR,—With reference to your note in this week's "JOURNAL" on my letter to a contemporary, *re* "Church Lighting," I am very conscious of the difficulties (in many cases arising from financial as well as architectural reasons) in planning a really satisfactory arrangement. But this is no argument for adopting any plan for scattering a few lights about the church, or in which the undoubted evils of unshielded filaments are permitted. This latter detail will, I am sure, be appreciated by you.

As to St. Paul's choir, I do not think any great exercise of thought is needed to arrive at a better arrangement than the present one. I always wonder how it was ever approved by the authorities.

As a gas-lighted church, you may perhaps not know that the famous old church of St. Bartholomew, Smithfield, is lighted by long rows of flat-flame burners carried along the walls. The mantle has apparently not penetrated so far into antiquity.

66, *Fenchurch Street, E.C.*, P. BENHAM, A.M.Inst.C.E.
Jan. 14, 1914.

Messrs. Biggs, Wall, and Co. have secured an order for one of their circular self-discharging sulphate of ammonia saturators, fitted with Williams and Fenner's patent outside cracker-pipe, for the Mackey-Seymour Coke-Oven and Engineering Company.

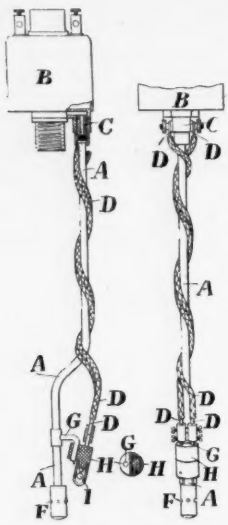
REGISTER OF PATENTS.

Lighting Gas-Burners.

HAVERS, E. W., of Highgate, N.

No. 28,653; Dec. 12, 1912. Reissued as No. 27,520; Dec. 12, 1913.

This apparatus consists of a valve for controlling the supply of gas to a main burner, combined with a secondary valve which is temporarily opened to allow a supply of gas to pass to a pilot burner for the ignition of the main burner; the object being "to provide a simple and effective device for lighting large lamps having a plurality of burners."



Havers' Gas-Lamp Lighter.

The pilot tube A is attached to the valve-actuating device contained within the casing B, at which the secondary supply of gas for the pilot burner issues. The tube A is attached to an insulating block C, to which are fixed conducting wires D. The tube near the burner mantles has a nipple E with side holes in number equal to the burners to be ignited, and arranged in such a manner as to direct a flame upon each mantle when the tube is supplied with gas. The tubular branch G carries an insulating block H, to which are attached the wires D, which convey the electric current to the igniter coil or filament I. The wires are connected to terminals on the insulating cap C. The block H is adapted to receive the electric igniter coil or filament I, and the branch G supplies a stream of gas which is ignited by the filament and is so placed as to project its own flame on the nipple E.

When operated, the secondary valve within the casing B allows a supply of gas to pass to the pilot tube A. Part of the gas passes through the tubular branch G, and is ignited by the incandescent filament I, and, in turn, ignites the jets issuing from the holes F in the nipple E, each of which jets lights its respective burner—the gas to the main burners having been simultaneously turned on. When the operating impulse ceases, the supply of gas to the pilot tube A is cut off; but the supply to the main burners is continued.

Distance Gas Lighting.

HAVERS, E. W., of Highgate, N.

No. 28,654; Dec. 12, 1912.

This distance control and ignition apparatus is of the kind which consists of a valve for controlling the supply of gas to a main burner combined with a secondary valve which is temporarily opened to allow gas to pass to an igniter for the ignition of the main burner.

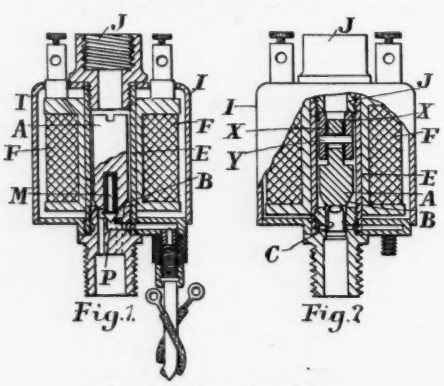


Fig. 1. Fig. 2.

Havers' Distance Gas-Lighter.

In fig. 1 the valve consists of a vertically disposed stem A formed with a coned base B, which normally rests upon a seating formed in a connection which is screwed into a non-magnetic sleeve E; the valve being adapted to rise and fall in the sleeve which forms an extension of the gas-passage. The entire valve (or its upper part only) is formed of steel, and is permanently magnetized.

Around the sleeve, in which the stem A works, is arranged a wound bobbin F, with terminals to convey electric current to it—the whole forming a solenoid. Outside the coil is an iron casing or sheath I, held in place by an iron socket J, adapted to be screwed at one end into the brass sleeve, and at the other end on to the gas-supply pipe. The casing I is brought over the top of the coil and continued to within a short distance of the upper end of the valve-stem, and so "collects the lines of force of the solenoid when excited, and exerts a powerful attractive and lifting force upon the steel stem of the valve."

In order to supply gas to a secondary burner, the valve stem A has a cavity in its base for some distance, as shown; and in this cavity is loosely fitted a rod M, of soft iron or steel with an intervening sheath to prevent direct contact with the permanently magnetized stem which surrounds it. The rod M (coned at its base) rests on a seating below that of the main valve A—being formed in the end of the secondary gas-passage P, which leads to a suitable point for connection with the igniter.

The operation is as follows: On the passage of a current of electricity through the coil F in one direction, the main valve A is lifted by reason of a pole being formed (at the point nearest the upper end of the valve stem) of a nature which attracts the upper pole of the permanently magnetized stem of the valve. The secondary valve M is also attracted and lifted with the valve A, and both valves are consequently held open. When the current in the coil is cut off, the magnetized stem of the main valve A is still held up by reason of its own magnetism; but the rod M of the secondary valve, not being permanently magnetized, and being surrounded by its sheath, falls and closes the passage to the secondary burner. Upon reversal of the current, a pole of opposite character is formed which repels the upper pole of the valve stem A, thereby releasing the main valve which then falls on to its seat, closing the passage to the main burner and shutting-off the gas.

In the modification illustrated in fig. 2, the main valve A is formed in two separate parts—one part A being formed with a coned base B as before, and being prevented from actual contact with the iron socket J; and the other part X forming a sleeve mounted upon a reduced portion of the valve A and connected with it by pin Y, which passes through a slot in the reduced part, as shown. At its base, the valve A terminates in a tubular piston C which slides fairly gas-tight in the parallel way below the seating above, and has openings in it by which gas passes to the main burner when the valve A is in the open or raised position. On the coil F being energized, both parts A and X of the valve are lifted, and the coned valve A and the piston valve C are both opened. When the energy ceases, the permanently magnetized part X is still held up to the iron socket J by reason of its magnetism; but the other part is released, and partly falls—being prevented from completely falling by the pin Y, which only allows it limited motion. The valve is therefore suspended in a mid-position, leaving the main gas-way open, but closing the passage to the secondary burner.

Valves or Cocks for the Control of a Series of Gas-Burners.

BOOTH, J., WEBSTER, F. A., SEN. and JUN., of Birmingham.

No. 7277; March 27, 1913.

The ports or passages in the plug and body of the cock are so arranged that, on turning the plug from the off-position, gas is admitted first to one burner only; on the further turning of the plug, the gas is admitted to two burners; and on still further turning the plug, the gas is admitted to three burners (and so on). An arrangement is made with the object of providing a temporary increase of the gas supply to pilot lights in connection with each of the series of burners so as to obtain "flash lights" immediately preceding the admission of gas to the first burner and almost immediately preceding each change in the number of burners to be lighted—the flash lights being reduced to pilot lights on the lighting of the burners.

Operating Control Valves of Gas-Burners from a Distance.

BERLIN-ANHALTISCHE MASCHINENBAU-AKTIENGESELLSCHAFT, of Berlin.

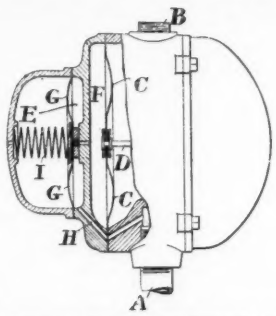
No. 13,603; June 12, 1913. Convention date, June 26, 1912.

This gas-burner valve operating mechanism is of the type wherein, on a temporary intentional increase in pressure taking place, a diaphragm is moved so as to open or close the valve supplying gas to the burner. Only when the pressure in the mains is intentionally increased does the opening of the control valve place the gas-supply pipe in communication with the casing of the "yielding pressure member." This member is then exposed to the full pressure of the gas; so that the whole energy of the gas is utilized for actuating the valve-operating mechanism.

Into the bottom of the casing shown opens the gas-supply pipe A, while to the upper portion is connected the branch B leading to the burner. In the casing is mounted the usual main pressure member C in the form of a diaphragm, the movements of which (produced by fluctuations in the pressure) are transmitted by a rod D to an operating device for the burner (not shown). Attached to the casing of the lighting device is a chamber, the inner space E of which communicates with the interior of the casing by a central opening formed in the partition F. When in the position of rest, the opening is closed by a disc-like valve secured to the central portion of the auxiliary pressure member G (in the form of a diaphragm) exposed on the one side to the pressure of the gas from the pipe A through the branch conduit H, and on the other side to the action of a spring I, the pressure of which can be adjusted in accordance with the particular actuating pressure employed. The chamber E communicates with the atmosphere by an opening; and the central portion of the partition F forms a seat for the inter-

changeable valve member of the control valve—having a larger diameter than the largest valve member used.

When the valve is in the position of rest (as shown), the increased pressure in the gas-pipe A H, which is produced for the lighting, acts only on the annular surface of the diaphragm G, which is not covered by the valve. As soon as the required operating pressure (for instance 60 mm. of water) corresponding to the pressure of the spring I has been reached, the valve moves away from the opening, so that the increased pressure can act to the full extent on the working diaphragm C. Owing



A "Bamag" Gas-Burner Control Valve.

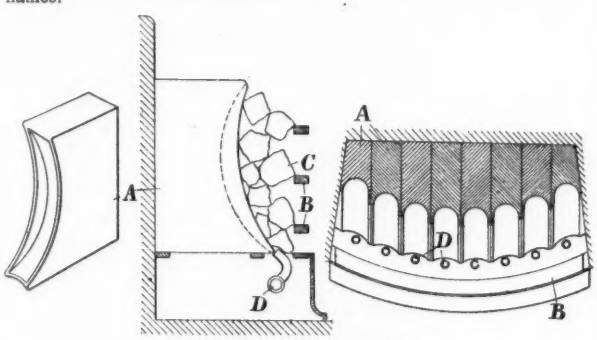
to the pressure of 60 mm. in the pipe A H then acting on the whole effective surface of the auxiliary diaphragm G (including the valve body carried by it), the spring I is forced back with a greater force corresponding to the pressure acting on this additional surface. Consequently the spring brings the auxiliary diaphragm back into the position ready for acting and closes the valve only when the pressure has sunk to an extent corresponding to the additional pressure on the auxiliary diaphragm G.

Gas-Fires.

BARRETT, S. R., of King's Heath, and YATES, H. J., of Aston, Birmingham.

No. 9928; April 28, 1913.

This invention has for its object to provide for the more convenient adaptation than heretofore of gas-fires to ordinary coal grates. It comprises the employment of a fire-brick back constructed in sections or blocks which can readily be fitted into an ordinary coal grate, and arranged to follow the contour of the front bars of the grate; as also the formation of such sections or blocks to provide channels for the burner flames, and also supports upon or against which the loose "fuel" can rest without interfering with the free passage of the burner flames.



Barrett and Yates's Gas-Fire.

In carrying the invention into effect as illustrated, a number of relatively thin blocks or sections A are employed—made of a mixture of fire-clay and sawdust in the proportion (*e.g.*) of two parts of fire-clay to one of sawdust. The blocks are preferably simply air-dried. If desired to be baked, they should be made as soft as possible, so that they can readily be cut to suit the grate into which they are to be fitted. A number of such blocks are placed side by side in the grate, presenting an edge to the front of the grate and leaving between the edge and the usual fire-bars B a sufficient space to accommodate loose fuel C. Preferably the front edge of each block is made to a concave cross-section so that it forms a channel along which the burner flame can pass. The fuel is placed across the front of the block, and by resting across the concave groove is prevented from interfering with the free passage of the flame.

Any suitable gas-burner D may be employed; the disposition of the jets being such that the flames can pass along the grooves in the fire-brick back.

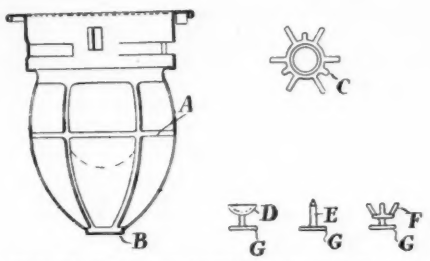
Gas-Burner with Protecting Device.

JULIUS PINTSCH AKTIENGESELLSCHAFT, of Berlin.

No. 15,081; June 30, 1913. Convention date, April 12, 1913.

In situations where it is of importance that a light is not totally extinguished, and where an emergency light is provided if the main lighting medium becomes defective for some reason, the patentees propose to employ an inverted incandescent burner in which a separate glowing body is provided in the bottom of the guard of the main flame, which glowing body is rendered incandescent by the flame that normally heats the mantle when the flame is extinguished.

Some forms of the invention are illustrated—a sectional elevation of the guard, and a plan view of one means of supporting the separate incandescent body (the upper portion of the guard being broken away). Also three different forms of the separate incandescent body in elevation.



Pintsch's Emergency Light Incandescent Burners.

At the bottom of the guard A, an annular and angular flange B is provided having lugs C between the guard bars adapted to fold down on the top of the flange G of the separate incandescent bodies.

A cup-shaped incandescent body is shown at D adapted to catch any fragments of the mantle falling down and to glow itself under the influence of the flame, and also to allow the fragments to glow. The incandescence of the fragments will, it is said, be increased if the cup is provided with air holes. The next illustration is of a conical pin-shaped separate body E on which fragments of the mantle may be impaled on falling. The third detail shows an outwardly extended crown of arms, which would combine the effects of both the other devices.

A further improvement is to apply within or near to the emergency device an automatic igniting device by means of platinum, platimoor, or the like material—that is to say, within the cup-shaped emergency device or on the bottom plate of the other forms—which would avoid the escape of unburnt gas in any case. But, as is pointed out, all devices are objectionable which glow when the main light operates properly, as also all devices attached to the lamp glass independently of the mantle, "because they render the cleaning of the glass difficult, they are easily damaged, and their replacement is often overlooked."

Money Boxes for Coin-Freed Gas-Meters.

FAIRWEATHER, H. G. C.; a communication from the Gesellschaft für Elektrische Industrie A.G., of Vienna.

No. 16,128; July 12, 1913.

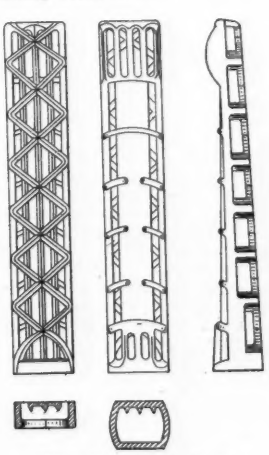
This money-box has a coin slot which renders impossible the unauthorized removal of coins by the person authorized to remove the money box—an automatically locking rocking member mounted on the inner side of the casing closing the slot on the receptacle containing the money box being opened, or on the removal of the money-box from the meter. The invention resides in the improved locking device, which is held by a bolt in the closed position (before locking the money-box) by a second bolt under the action of a spring in an intermediate position, from which it is brought into the open position (on closing the door of the receptacle for the closed money-box) by a pin mounted on the door and directly acting on the rocker.

Fuel for Gas-Fires.

WILSON, W. A., of Armley, near Leeds.

No. 16,571; July 19, 1913.

This fuel for gas-fires is so arranged and constructed that, when a number of pieces are assembled in a gas-fire, "an appearance of a continued pattern or network to the front is produced, so taking away the effect of several upright columns or pillars which is usually obtained with fuel as now generally constructed."



Wilson's Gas-Fire Fuel.

Front, back, and side views of the fuel are given; also sections of the upper and lower parts.

The fuel is formed from suitable material into a body of suitable length; the sides being parallel, the front and back approaching towards the top in relation to each other. The front face is flat and

composed of a network of such a pattern that when two or more pieces of fuel are assembled the pattern will appear continuous. The side members comprise two parallel ribs, which support the front network and also the back portion, which is formed substantially flat on its outer face. The inner face in one form is provided with vertical ribs to act as a strengthening means, against which the flames impinge. In other forms, these ribs are replaced with projecting points or other suitably shaped ribs, projections, or the like.

The back portion is pierced towards the base and towards the top with slots at the sides, the remainder of the back presenting a solid face to the action of the flame and to the brick forming the back of the fire. The upper back perforations permit of the escape of the products of combustion.

The patentee says he anticipates that, with fuel constructed as described, "not only a more pleasing appearance will be given to a gas-fire, but there will be an increased efficiency over and above fuels constructed in the ordinary manner with open, or comparatively open, backs, in that the solid central portion of the back prevents undue loss of heat to the back brickwork, and therefore increases, or tends to increase the radiant efficiency of the fire."

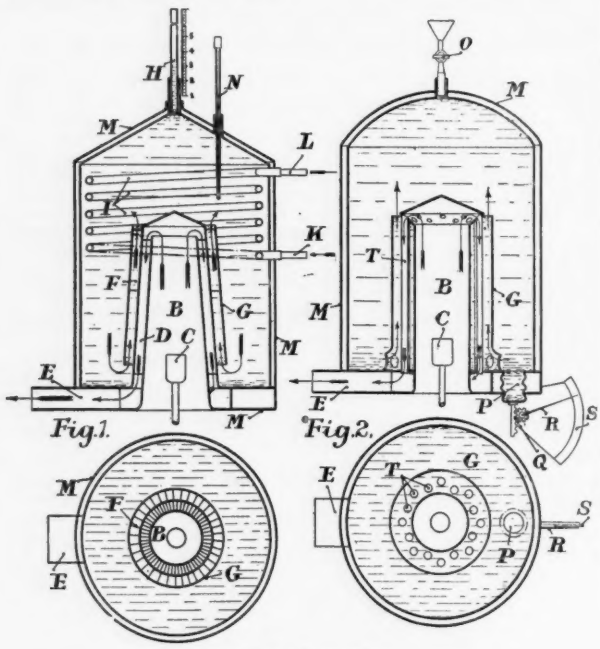
Measuring the Heating Value of Fuels.

JUNKERS, H., of Aachen, Germany.

No. 22,514; Oct. 6, 1913. Convention date, Oct. 16, 1912.

This invention relates to a method for measuring the heating value of fuels, and calorimeters for carrying out the method; and the patentee points out that one and the same apparatus as shown in the illustration may be used for the calorimetric examination of solid, liquid, and gaseous fuels—all that is necessary being to provide a burner suitable for the kind of fuel to be examined in each case.

The method consists in using a calorimetric vessel filled with a definite quantity of liquid, and allowing the hot gases given off during the combustion of the fuel to flow past heating surfaces which transmit the heat of the gases completely to the liquid contained in the calorimeter. The measurement of the heat, which when divided by the weight of fuel consumed gives the heating value sought, is performed by means of a special measuring device which is attached to the calorimeter, and measures the increase in volume sustained by the liquid in consequence of the heating of it.



Junkers' Calorimeters.

In order that this increase in volume may bear a constant ratio to the amount of heat taken up by the liquid (and which ratio, used as a multiplier, gives this amount of heat), use is made of such a liquid as possesses a co-efficient of expansion which is independent of the temperature, and remains constant within the limits of temperature coming under consideration. Unless this be the case, he points out, the increase in volume can only stand in a definite ratio to the amount of heat absorbed provided all parts of the liquid are at exactly the same temperature. The attainment of this condition must be attempted by means of a stirring device, kept in operation during the experiment; but this complicates the work and is unreliable, especially in the larger forms of the apparatus.

If, on the other hand, notwithstanding different increases in temperature, the particles of the liquid expand uniformly in relation to the increase in temperature, the total expansion is just as great as though all the particles were at exactly the same temperature—stirring being in this case unnecessary. According to the researches of the applicant, petroleum, for example, is admirably adapted for carrying out the method, since its co-efficient of expansion is constant at all the temperatures coming under consideration. On the other hand, water is not very suitable, and its use would render the employment of a stirring device necessary.

In the present method, the determination of the heating value is performed by merely reading off the height of the liquid in the measuring tube of the calorimeter before and after the experiment, multiplying the difference by a constant, and dividing the product by the amount of fuel consumed. The only correction needed in any event would be for the exchange of heat with the environment; and this could be determined in a very simple manner. But, as pointed out, it has been found that this correction may be neglected if the quantity of liquid contained in the apparatus is so large in relation to the amount of fuel consumed that the liquid is only slightly heated by the combustion.

In order to keep the difference in temperature between the liquid and the room as small as possible, the liquid can, before each experiment, be adjusted to a desired temperature, by means of a special device, when it is not desired to wait for the very long time necessary in the case of well-insulated apparatus for the temperature to equalize naturally.

In fig. 1 the calorimeter vessel containing the measuring liquid has a combustion shaft B, in which the hot gases liberated by the combustion of the fuel in the burner C ascend in order to pass downward again through the heating passages D and escape through the exhaust outlet E. The combustion shaft and heating passages are provided with heat exchanging devices "which ensure complete transmission of the generated heat to the measuring liquid." In fig. 1, the heat is taken up from the gases by gills arranged in the heating passage, and is given off to the measuring liquid mainly through gills F projecting into the liquid. A more active circulation of the liquid, and therefore an improved transmission of heat to it, are obtained by means of the jacket G which surrounds the gills.

A glass tube H, fitted with a scale, is provided for measuring the increase in the volume of the measuring liquid in this form of apparatus. Special heat exchanging devices are provided for adjusting the initial temperature of the measuring liquid. For this purpose, there is a coiled tube I (terminating in connections K and L), through which a cooling or heating medium is passed as required. The actual calorimeter is surrounded by an insulating jacket M to prevent radiation of heat.

Fig. 2 illustrates another form of the apparatus. Here a different arrangement is adopted for transmitting the heat of the gases of combustion to the measuring liquid. It is effected by heating tubes T communicating with the combustion passage B and surrounded by the measuring liquid. The gases of combustion passing from above downward through these heating tubes give up the whole of their heat to the measuring liquid surrounding the tubes T. For measuring the expansion of the liquid, the apparatus is provided with an elastic membrane P, the movement of which is transmitted, by pinion gear Q, to the pointer R, the position of which can be read off on the scale S. In place of the ascending tube shown in fig. 1, the apparatus is provided with a cock O, to be closed when the apparatus has been filled, so as to prevent air entering and the liquid escaping.

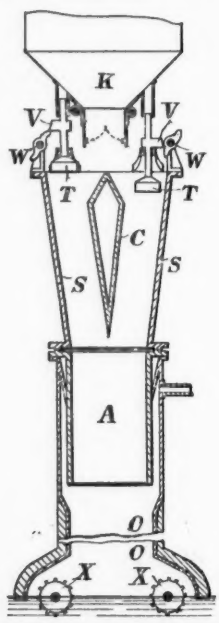
The calorimeters in all cases must, it is said, be made in such a way that no air bubbles, which would impair the accuracy of the results, can adhere in any part of the chamber containing the liquid—a result which can be attained by the conical or domed shape given to the top of the measuring vessel.

Continuous Gas-Retorts.

OSWALD, W. VON, of Coblenz, Germany.

No. 24,234; Oct. 25, 1913.

This invention consists more particularly in a retort in which the fuel is introduced or packed with uniform density or tightness into a feeder piece, and the forward movement of the coke down the retort is stimulated by moving members, such as rolls.



Von Oswald's Continuous Gas-Retort.

The invention is illustrated by a "somewhat diagrammatic view" of the upper and lower ends of a retort in cross-section, the central part or retort proper being omitted.

A metal feeder piece A is arranged on the top of the distillation chamber O. The feeder piece corresponds in shape to that of the distillation chamber; and the dimensions are such that a space is left

around the feeder to collect the gas; and from this space the gas is withdrawn. Above the feeder there is arranged a filler S "designed to meet the requirements of the method of filling which it is proposed to adopt." The fuel is supplied from a bunker K, having flaps or doors at its lower end to control the rate of feeding of the fuel. On the upper end of the filler there is mounted mechanism for operating stamping or packing members T. This consists of shafts W having cams adapted to engage on heads or rims V on the stampers. The cams raise the stamps, which then fall by gravity on to the fuel and "pack it to a uniform degree of tightness."

The filler is of tapered form; and as it is desired to introduce a tightly packed body of fuel into the feeder, it has a centrally arranged inset piece or cross-beam C extending from side to side of it. This inset piece widens from the foot to a point near the top of the filler, and then again narrows to the actual top. "This ensures the required degree of tightness of packing the fuel passing to the feeder."

The stampers T fulfil yet another purpose. Their impacts "cause a vibration to pass to the material in the distillation chamber, which facilitates its downward movement and prevents stoppage by caking or adhesion to the walls. Further, when a stoppage occurs, the stampers, in virtue of their free falling movement, act as indicators. The stoppage would cause a heaping of the coal beneath the stampers, so that in course of time these would remain in the position to which they had been raised by their cams. The attendant is then given a visual and to some extent also an audible signal that a stoppage has occurred and the required remedies may be applied."

The coke passes down the distillation chamber to find its egress in a sump or trough at the foot. At this point the movement or removal of the coke is promoted by rolls or like moving members X provided with projections or blades on their surfaces. The speed of rotation of the rolls is adjusted to suit the rate of sinkage of the coke; so that there is no pulling action on the coke—the rolls should just support and promote the natural movement of the coke. The rolls are disposed wholly or partially in the water of the sump, so as to retain them comparatively cool.

LEGAL INTELLIGENCE.

AN INCOME-TAX APPEAL.

An important point in income-tax practice has just been decided by the Special Commissioners of Income-Tax, in an appeal by the Bishop's Stortford, Harlow, and Epping Gas and Electricity Company against an assessment of the profits for the year 1911-12.

By the Bishop's Stortford, Harlow, and Epping Gas and Electricity Act, 1910, the undertakings of the Bishop's Stortford and District Gas Company, Harlow and Sawbridgeworth Gas Company, Epping Gas Company, Ongar Gas Company, Limited, Newport Gas Company, Limited, and Much Hadham Gas Company, Limited, were amalgamated, as from Jan. 1, 1911. The local Surveyor of Taxes assessed the profits of the amalgamated Company for the first year (1911) upon the total profits of the several amalgamated Companies for the preceding year (1910). Against this assessment the Company appealed to the Special Commissioners; the appeal being heard at Cambridge in December, 1911. The case was then adjourned. The appellants (who were represented by Mr. E. L. Burton, F.S.A.A) contended that, owing to a specific cause, the profits of the amalgamated Company for the year of assessment would be less than the sum of the profits of the several amalgamating Companies for the year 1910. It was claimed that the specific cause was that some of the conditions under which the amalgamated Company were working were in material respects dissimilar to those of the several pre-existing Companies, owing to, *inter alia*, (*a*) rearrangements of the staff and the remuneration paid to them necessitated by the amalgamation, (*b*) the reductions in the price of gas made in certain areas within the new limits of supply, (*c*) the laying of connecting trunk mains, (*d*) the closing of some of the manufacturing stations, &c. The Company's contention was resisted by the Surveyor of Taxes, acting upon the instructions of the Commissioners of Inland Revenue.

The Special Commissioners, at the adjourned hearing on the 12th inst., after further argument put before them by Mr. Burton and the Surveyor of Taxes, gave their decision in favour of the appellants, and allowed the appeal. It should be added that the Company further claimed an allowance for depreciation—*i.e.*, for diminished value by reason of wear and tear in respect of gasholders, meters, stoves, &c. The original assessment was £7251 10s.; and this was reduced by the Special Commissioners to £5471—the amount allowed by them for wear and tear being £928.

The case will no doubt be of interest to the officials of companies who have recently amalgamated, or who are contemplating an amalgamation of their undertakings.

ACTION AGAINST TAR DISTILLERS.

In the High Court of Justice last Tuesday, before Mr. Justice Warrington, an action was brought by Mr. Joseph A. Hutchison and Mrs. Eliza Hutchison (his mother), who hold all the shares in the Burnden Tar Company, of Bolton, against Messrs. Major and Co., of Hull, for the specific performance of an agreement for the sale of shares and debentures in the plaintiff Company.

Mr. CAVE, K.C., for the plaintiffs, said that the Burnden Tar Company's business consisted in the purchase of tar from gas companies and corporations. They gave the tar a first distillation, producing light and heavy oils, which they sold to distillers, who carried out a further distillation. The great feature of the business was its connection with a number of corporations and gas companies in the Midlands and the North of England. Several attempts had been made by other distillers to buy-up the Company; but they came to nothing. An agreement was, however, drawn up on Feb. 18 last year for the sale of the shares in the Company to the defendants. Allegations were afterwards made against the plaintiffs of misrepresentation. These charges were denied. The agreement had never been carried out; and the plaintiffs claimed accordingly.

Mr. *Joseph A. Hutchison* stated in evidence that after the agreement was signed, Mr. Major, of the defendant Company, availed himself of the powers in the agreement to visit the plaintiffs' works. He told him (witness) not to enter into any contracts except on his instructions. Mr. Major also instructed him with regard to prices.

The hearing was adjourned; and subsequently evidence was given regarding the agreement and the alleged misrepresentation.

His LORDSHIP gave judgment for the defendants on the question of agreement to purchase the shares. He held that the plaintiffs were not ready to complete on April 1, and therefore were not entitled to specific performance, and the defendants were entitled to have the return of the deposit they had made of £500.

British Coalite Company's Capital.

Last Tuesday, in the Chancery Division of the High Court of Justice, Mr. Justice Astbury heard the petition of the British Coalite Company, Limited, for the sanction of the Court for the reduction of their capital from £2,000,000 to £400,000. The proposed reduction was part of a scheme for the reorganization of the Company's capital, involving both subdivision and consolidation. The capital of the Company was £2,000,000, divided into 1,500,000 ordinary shares of £1 each, and 500,000 deferred £1 shares. It had issued 723,372 ordinary shares, which were fully-paid, and 710 ordinary shares, which had been forfeited for non-payment of calls. The whole of the 500,000 deferred shares were fully-paid—leaving 778,918 ordinary shares unissued. The Company alleged a loss of £976,866; and to provide for this it was proposed (1) to cancel two ordinary shares, £2; (2) to write 16s. off 721,080 issued ordinary shares, £576,864; (3) to write 16s. off the 500,000 issued deferred shares, £400,000—total, £976,866. His Lordship sanctioned the proposed reduction.

Stealing Gas at Manchester.

Ernest Clayton, of Moston, was fined £5 and costs, with the alternative of one month's imprisonment, by the Manchester Magistrates on Saturday for stealing approximately 16,500 cubic feet of gas during the last twelve months. It was shown that for the year 1912 the defendant consumed gas which averaged 7s. per month; but the first three months of 1913 showed the consumption to be less than half this quantity. In the succeeding three months, the total amount was only 7s. 6d. Defendant carried on business in a smaller way. Accompanied by two detective officers, Mr. J. W. Southern, one of the inspectors in the Gas-Fittings Department, visited the defendant's premises on Friday morning, and demanded admittance, which was refused. Through a window the detectives saw the defendant with a monkey-wrench in his hand, tampering with the meter connections, and with the unions connecting a hot-plate. Gas for the hot-plate had evidently been procured by flexible metallic tubing. Accused, who pleaded guilty, said he was in poor circumstances, or he would not have committed the theft.

New Gasholder for Stafford.

The report of the Gas and Electricity Committee was adopted at last Tuesday's meeting of the Stafford Town Council, when it was reported that the output of gas during the last financial year had been a record one, and that another record was expected by the end of March. The Electricity Department, however, showed a small decrease. Increased business had necessitated the erection of a new gasholder, for which seven tenders had been received. The lowest—that of Messrs. C. & W. Walker, Limited—had been accepted for a three-lift holder with steel tank, to contain a million cubic feet of gas. At present only 650,000 cubic feet can be stored, but in the near future the average daily output is expected to reach a million. Without the tank, the holder will weigh about 220 tons, and is to be 117 feet in diameter by 36 feet deep. It is hoped that the holder, the design and specification for which have been prepared by the Engineer, Mr. W. M. Valon, will be ready for use next winter.

Conway Gas-Works Litigation.—With reference to the lawsuit which recently took place between the Conway Town Council and Mr. Albert Wood, regarding an alleged nuisance from the gas-works, it was stated in the Council that the taxed costs of the action amount to £1200, and a further £1200 on account of disbursements paid out by the Council's Solicitor. It was decided to pay the amount; and the Town Clerk (Mr. H. Parry) was instructed to arrange with the Treasurer for the opening of a suspense account at the bank, pending the result of the appeal against the decision of the High Court, which has already been lodged.

Holywood Water-Works Extension.—Mr. P. C. Cowan, Chief Engineering Inspector of the Local Government Board for Ireland, held an inquiry last Wednesday at Holywood (co. Down) into the application by the Urban District Council for a Provisional Order under the Irish Public Health Acts, 1878 and 1907, and for sanction to a loan of £4500 for the purpose of providing a new storage reservoir, &c., in connection with the water-works. The proposed new reservoir will have a capacity of 22 million gallons, with top water 500 feet above Ordnance datum; when raised to 505 feet for future requirements, it will hold 36 million gallons. Mr. James Hanna (the Town Surveyor) said he would favour the raising of the reservoir to the 505 feet level at once; and the Inspector remarked that he would recommend the Council to act on his idea.

MISCELLANEOUS NEWS.

SULPHATE OF AMMONIA MARKET.

Messrs. Bradbury and Hirsch's Review for the Past Year.

We have received a copy of the "Review of the Market for Sulphate of Ammonia" in the past year, which has been issued by Messrs. Bradbury and Hirsch, of Liverpool. It contains, as all its predecessors have done, much that is of interest to "JOURNAL" readers; and we therefore extract from it the following particulars.

RELATIONSHIP BETWEEN NITRATE OF SODA AND SULPHATE.

Before proceeding to review the nitrate of soda and sulphate of ammonia trades during 1913, Messrs. Bradbury and Hirsch think that it may be appropriate to make a few observations upon the general relationship of the two articles with each other and with atmospheric nitrogen products, since all of them come on to the same ground, are used more or less in the same way, and must remain in close competition with each other. They take nitrate of soda first, and observe that, being a primary product, the rate of its output must be determined by its own market value, if disaster is to be avoided. Every combination among producers to restrict output has been an admission on their part either that a non-paying price has been reached or has been in sight—that productive capacity has got ahead of demand. The market price is everything in this industry, and the combination for the restriction of production of output arranged in August last shows that the margin of profit was at that time in danger of being extinguished. The case of sulphate of ammonia is altogether different, because it is a bye-product. The rate of its output is determined by other considerations than its own market price; and so long as there is demand for coke and coal gas, so long will sulphate of ammonia continue to be produced, no matter what its own selling price may be. Atmospheric nitrogen fertilizers are primary products; and the line to reasoning followed in the case of nitrate of soda applies equally of them. The rate of output must ever be determined by their own selling price.

The first conclusion the authors arrive at is, therefore, that sulphate of ammonia cannot be ousted by either nitrate of soda or atmospheric nitrogen products. The second is that the latter products, having a wider margin of profit, must eventually beat nitrate of soda if it comes to a struggle where the two articles can be used indifferently, but that they are still feeling their way into more general use, and are not yet a serious menace to nitrate of soda. This would, however, seem to be in the weakest position, and would stand to be hurt most if there should be a question of reducing prices further. There are indications of the attitude of producers towards the question of the total supply of nitrogenous fertilizers; and in extending their plant and erecting new works, makers of atmospheric nitrogen products are giving an indication of theirs. So far the annual output has not quite reached 200,000 tons. But Messrs. Bradbury and Hirsch state that in 1914 there will be a further substantial increase; and though, in relation to nitrate of soda and sulphate of ammonia combined, it is not yet quite 5 per cent., it must in future be taken seriously into account. They say the prediction of Sir William Crookes at Bristol in 1898, that the atmosphere would be the ultimate source of nitrogen for fertilizing purposes, has, in fact, already begun to be realized.

NITRATE OF SODA.

When discussing the situation at the end of 1912, Messrs. Bradbury and Hirsch took occasion to point out several important factors which seemed to them likely to restrain shipments to Europe over the early months of 1913. The weak points in the European situation were the much larger supply of sulphate of ammonia in Germany, and the low price obtainable for the 1913 crop of beet sugar. There was, in fact, no prospect of any increase in the consumption of nitrate of soda on the Continent; and seeing that the quantity in the interior was probably 40,000 or 50,000 tons more than that at the end of 1911, they thought that deliveries from Hamburg might even shrink to this extent. The prospects for consumption in the United States were, however, far better than they were at the end of 1911, and increased consumption there could only be met by substantially larger shipments over the near months—large enough, it was thought, to relieve any pressure upon the European market which might otherwise arise. Therefore, from the point of view of actual supply for the spring months, they could not see that the European market was at all likely to be overloaded. The actual supply for January-April proved to be 1,149,000 tons; deliveries from United Kingdom and Continental ports, 1,018,000 tons; and stocks at these ports on the 30th of April, 131.000 tons.

Though Messrs. Bradbury and Hirsch's estimate for January-April was 44,000 tons less than the actual supply for the corresponding period of 1912, it proved to be 65,000 tons over the mark. The difference was due to the strong demand from the United States, which was sustained from the outset right over the spring months; and they think it is unnecessary to look for other reasons for the serious shrinkage in shipments to Europe in the early months of the year beyond hose which they suggested in their 1912 "Review," and which they have repeated. Assuming the correctness of their estimate of supply for Europe in the January-April period, they thought it might be sufficiently absorbed to maintain prices at the opening level; but they did not consider that any higher level was justified.

Deliveries in January were fairly well maintained; but in February and March there was a heavy falling-off, so that by the end of March the total shrinkage in deliveries, compared with those for January-March, 1912, amounted to no less than 177,000 tons. April deliveries, however, were exceptionally heavy; and by the end of the month the total shrinkage for the four months had been reduced to 114,000 tons. There was nothing special about deliveries in May and June. They were practically the same as those for May and June, 1912; so that the net shrinkage for the six months was 118,000 tons. In the meantime, there had been a large and steady increase in shipments to the United States; the total for the six months amounting to about 150,000 tons—say 60 per cent. increase. While keenly alive to the significance of the strong demand for the United States, dealers in Europe persistently closed their eyes to the weak points in the European situation already referred to.

The year opened with a good demand, and sellers, taking advantage of what they conceived to be their strong position—comparatively small stocks—pushed up the price from 11s. 6d. to 11s. 10½d. per cwt. in January. Early in February it was advanced to 12s. 1½d. per cwt.; but in face of rapidly diminishing deliveries from Continental ports, it was dropped to 12s. later in the month. Notwithstanding the shrinkage in deliveries in February and March—together 164,000 tons—the price was maintained at 12s per cwt. all through the latter month; but in April there was a decline to 11s. 9d., though there was within the month an increase in deliveries of 64,000 tons compared with those in April, 1912. It had become obvious that, owing to the abundant supply and relative cheapness of sulphate of ammonia, the supply of nitrate of soda was going to be too much for the remaining spring demand; and in May there was a drop to 11s. per cwt. In June the situation had become hopeless, and there was a further drop to 10s. 7½d. per cwt.

Early in July the price fell to 10s. 4½d. per cwt.; but when the question of restricting production, decided upon by the producers, was taken in hand seriously, there was a recovery to 10s. 6d. per cwt. In August there was a further advance—to 10s. 9d.—and it was maintained up to October, when there was a decline to 10s. 7½d. In November the price declined to 10s. 4½d. per cwt.; and at the end of the month the visible supply was still 62,000 tons more than that at the end of November, 1912, though deliveries from the ports for the five months July-November had been only 4000 tons less than those during the same months in 1912. In December there was a recovery to 10s. 6d. per cwt.—the closing price; the visible supply being 107,000 tons in excess of that at the end of 1912. The average price for January-June was 11s. 6½d. per cwt.; that for July-December works out to 10s. 8½d. per cwt. The average for the whole year is therefore 11s 1½d. per cwt., *ex* store in Liverpool, less 2½ per cent., or just ½d. above the average for 1912.

West Coast prices are per quintal and free alongside, and, thanks to the exceptional demand for the United States during the first six months of the year, they work out almost equal to those in 1912, notwithstanding the slump which came in March and June. From 8s. 1½d. at the outset there was an advance in January to 8s. 2½d., and in February to 8s. 4½d. There was a set-back to 7s. 11d. in March and to 7s. 10d. in April. In May the price became 7s. 9d., and in June 7s. 6d. There was a recovery to 7s. 7½d. in July; and in August, when combination for restricting the output became imminent, and when increased interest was attracted, there was a sharp advance to 7s. 11d. Through August, September, and October, there was practically no fluctuation from 7s. 11d.; but in November the price, after declining to 7s. 8d., recovered to 8s. In December the price was maintained at about 8s. up to the close.

The average price for January-June works out to 8s. per quintal, or 5¼d. per quintal more than the average for the first half of 1912. That for July-December is 7s. 10d. per quintal, or 7¾d. below the average for the corresponding period of 1912. The average for the twelve months is thus 7s. 11d. per quintal, or 1¼d. per quintal below that for 1912. Having regard to the vicissitudes through which the market has passed, Messrs. Bradbury and Hirsch think this result should be regarded as highly satisfactory, especially when account is taken of the extravagant rates of freight which were current up to April.

The production during the year is estimated to have been about 2,720,000 tons—an increase of some 170,000 tons upon the output in 1912, notwithstanding the restriction which has been in force since August. The visible supply (stock and afloat) for the United Kingdom and the Continent (including Egypt) at the end of 1913 was about 1,066,000 tons, compared with 959,000 tons at the close of 1912 and 1,052,000 tons at the corresponding period of 1911. The present visible supply is thus 107,000 tons larger than that at the end of 1912. Messrs. Bradbury and Hirsch remark, however, that before they can begin to discuss the prospects of the market they must consider what the actual supply for the ensuing four months is likely to be. In the absence of anything authoritative to the contrary, they are bound to assume that the restriction upon production will cease at the end of January; and, seeing that since August it has left at the end of the year a visible supply larger by 107,000 tons than that at the end of 1912, and that stocks on the West Coast are quite up to the normal for the end of December, they do not think there is much to encourage heavy shipments to Europe over the early months of the present year. Neither do they see very much to induce heavier shipments to the United States. There is in the price of cotton every inducement to fertilize on the most liberal scale. But this was the case last season; and it is known that American buyers are now more largely committed to sulphate of ammonia than they were a year ago.

The quantity of nitrate of soda which was shipped to Europe last year, and which arrived before the end of April, was 190,000 tons. Messrs. Bradbury and Hirsch do not think we can count upon more than 220,000 tons in the current year; and if this quantity is added to the present visible supply of 1,066,000 tons, we shall have an actual supply for Europe and Egypt of 1,286,000 tons, or 137,000 tons more than that for the period from January to April last. Assuming an actual supply to the amount named, the authors proceed to the discussion of the prospects of the market over the coming season. The first facts which confront them are the substantially larger supply of sulphate of ammonia in Europe and the attitude of German producers, who have shown their willingness to sell ahead at the level of spot prices over the next three years. They are determined to hold their ground whatever the action of the nitrate of soda interest may be; and as sulphate of ammonia prices are relatively cheaper than those for nitrate of soda, the chances of any improvement in the latter seem to be somewhat remote. Then, not only is the visible supply 107.000 tons larger than that at the end of 1912, but the proportion of stock is much greater; so that there cannot at any time be actual scarcity of the available supply. Again, if the restriction of production is removed

at the end of the current month, it is not likely that dealers and distributors will care to hold up supplies until production once more gets ahead of consumption and the market again goes to pieces.

Messrs. Bradbury and Hirsch are hoping to see a substantially larger consumption of nitrogenous fertilizers in the aggregate, owing to the lower level of prices all round, which amounts to greater spending power on the part of buyers, and to the world's larger requirements in foodstuffs as each year passes. They trust nitrate of soda may participate in this larger consumption; but they say it will require to be judiciously handled, and with some restraint on the part of producers, if even the present level of prices is to be maintained over the coming season.

Sulphate of Ammonia.

Coming to sulphate of ammonia, Messrs. Bradbury and Hirsch say the outlook at the end of 1912 was by no means encouraging, and they were unable to take a sanguine view of it. Notwithstanding the confidence of German producers in the capacity of their market to absorb their increased output as well as the very heavy stocks being carried over into 1913, they could not be sure that this confidence was entirely well placed, At all events, there was no probability of increased demand for English production for the Continent. It seemed to them hopeless to expect increased demand for Japan for delivery over the first four months of 1913; and the best that could be expected from the sugar-growing colonies was that the level of 1912 spring requirements might be maintained—the drop in the price of sugar being calculated to discourage intensive fertilizing. Owing to the increased home output of sulphate of ammonia in Spain and to the larger use of nitrate of soda there, the authors had to say that any large increase in the demand for sulphate in that direction could not safely be counted upon. The United States seemed to be the land of promise, for, though shipments in November and December had been very heavy, it was thought that others on something like the same scale would be made over the early months of 1913; the high price of cotton seeming to justify the cultivation of the largest practicable area and fertilizing on the most liberal scale. In order to show the actual trend of exports, Messrs. Bradbury and Hirsch next give the tables of exports drawn up as in previous years. The following are the totals for the past and the preceding year:

	Year 1913. Tons.		Year 1912. Tons.
France, Germany, and Belgium	23,521	..	9,539
Spain and Portugal, Italy, and the Canaries	70,237	..	83,150
Holland, Java, British Guiana, the West Indies, and Mauritius	60,275	..	52,875
Japan	114,684	..	86,659
United States	37,067	..	39,333
Other countries	18,920	..	15,308
Total exports	324,704	..	286,864

Statistics as to Prices.

Though stocks in the hands of producers when the year opened were large, Messrs. Bradbury and Hirsch say they were not inconveniently heavy; but the factors upon which the stability of the market must depend were so far uncertain that the extreme firmness of sellers when the campaign opened did not seem to be justified. However, almost immediately the price was pushed up from £14 5s. to £14 6s. 3d., and then to £14 7s. 6d. per ton; but in February there was a drop to £14 2s. 6d. —the only really healthy feature in the market being the demand for the Continent, the quarter from which it was least expected. In March, the United States requirements being little more than 500 tons, and Germany having stepped into the market for the Dutch East Indies, exports were so far disappointing that the price dropped to £13 17s. 6d. without relieving the situation appreciably. In April, notwithstanding exceptionally heavy exports, there was a decline to £13 11s. 6d., supplies being still too abundant; and in May there was a drop to £12 18s. 9d., the nitrate of soda market having collapsed. The largely increased shipments to Japan and the sugar-growing colonies, and sustained demand for the Continent in May and June, had the effect of steadying the market in the latter month, though there was then a decline of a further 2s. 6d. per ton. The situation did not alter very much in July, and the price remained at the dead-level of £12 16s. 3d. per ton; but in August, the demand being well sustained and the combination of nitrate of soda producers having been announced, there was a recovery to £13 6s. 3d. September shipments were heavy—upwards of 28,000 tons—and there was an advance to £13 12s. 6d. But supplies were becoming more abundant with the approach of the winter months, and in October there was a set-back to £13 1s. 3d., notwithstanding very heavy shipments in that month. In November there was a gradual decline to £12 17s. 6d, and in December £12 16s. 3d. became the price; for though requirements for the month were very large, the market at no time responded, it having got abroad that German producers had reduced their prices, and United Kingdom producers everywhere being anxious to market their output.

The average price for January-June was £13 13s. 7d. per ton, or 18s. 2d. below the average for January-June, 1912. The average for July-December works out to £13 1s. 6d. per ton, or 22s. 2d. below the figure for July-December, 1912. The average for the year is therefore £13 7s. 6½d. per ton, or £1 0s. 2½d. below that for 1912. Messrs. Bradbury and Hirsch say it must be confessed that the result is disappointing, though, when the facts are reviewed, they do not see that a better result was possible.

The output of sulphate of ammonia in Germany last year is estimated to have been 550,000 tons; in the United Kingdom, 420,000 tons; in France, 75,000 tons; in Belgium, 51,000 tons; in the United States, 193,000 tons; and in Austria-Hungary and the rest of the world it may have amounted to 150,000 tons. So that, according to the best information Messrs. Bradbury and Hirsch have been able to obtain, the world's output for the year reached 1,439,000 tons. The output in the United Kingdom in 1912 showed an increase of only 3000 tons upon the output in 1911; the causes being the stoppage of carbonizing works in March, April, and May by reason of strikes at the collieries and the consequent dearth of coal, and the larger recourse to water gas at the different gas-works. There was nothing in 1913 to interfere with continuous operations at the carbonizing works; but, owing to the dearness of oil, the use of water gas was much reduced, and the output of sulphate of ammonia from gas-works substantially increased. The production of ammonia, calculated into sulphate (including that used in the manufacture of ammonia soda and for other chemical purposes), from all sources in the United Kingdom during the past year is estimated at 420,000 tons, apportioned as follows:

	Tons.
Gas-works	182,000
Iron ,,	19,000
Shale ,,	62,000
Coke and carbonizing works and producer gas	157,000
	420,000

Of this quantity, Messrs. Bradbury and Hirch estimate that England contributed 292,000 tons, Scotland 125,000 tons, and Ireland 3000 tons. The production (in tons) the previous four years was as follows:

	1912.		1911.		1910.		1909.
Gas-works	172,000	..	169,000	..	168,000	..	164,000
Iron ,,	17,000	..	20,000	..	20,000	..	20,000
Shale ,,	62,000	..	61,000	..	59,000	..	57,000
Coke and carbonizing and producer gas	137,000	..	135,000	..	120,500	..	107,500
Totals	388,000	..	385,000	..	367,500	..	348,500

Their estimate of production in the United Kingdom in 1912 was 9000 tons below the mark. It consequently follows that their estimate of home consumption was under the actual quantity; and it is probable that the stocks in the hands of producers at the end of 1912 were larger than was supposed. Home consumption might have been as much as 95,000 tons; and if so, there would be 22,000 tons of stock in the hands of producers and in transit to shipping ports. Assuming this, the account for 1913 will stand as follows:—

	Tons.
Stocks brought forward from 1912	22,000
Production during 1913	420,000
	442,000
Exports during 1913	325,000
Home consumption (for all purposes) in 1913	97,000
Stocks to carry forward into 1914	20,000
	442,000

Prospects of the Market.

The portion of the "Review" in which Messrs. Bradbury and Hirsch deal with the prospects of the markets is a specially interesting one. In the course of it they make the following remarks: We do not think the rate of increase in output in Germany which has been witnessed in recent years can be maintained in 1914. The phenomenal increase in output has been due partly to expansion in the demand for coke—the primary product of carbonizing—and partly to the adoption of closed ovens in the place of "beehives," by which means the residuals ammonia water and tar are recovered. The same causes have operated in the United Kingdom and elsewhere, and there has been a further incentive. It has been found that refuse coal will do for carbonizing in closed ovens; and this discovery has led to the erection of ovens at many of the large collieries for the purpose of working-up the small stuff which was formerly either a drug on the market or else thrown aside altogether. Carbonizing works of this kind will be kept going, of course, and other works of the kind will, no doubt, be erected. But the prospects of an increased demand for coke in 1914 are not rosy; and it will be fortunate if ovens where more expensive coal is carbonized are not compelled to close down. For this reason we do not look for an increase in the output of sulphate of ammonia either in Germany or in the United Kingdom at all on the scale of the increases in 1912 and 1913.

In view of present and prospective supplies, what are the prospects of the market over the coming spring months? We will discuss the situation in Germany first, since Germany is now the most important country in the sulphate of ammonia world, both as producer and consumer. In the first place, there will be a much larger supply of sulphate of ammonia than there was over last spring months, and there will be at least 100,000 tons more nitrate of soda on the European market—a rather important fact, seeing that last season's supply of nitrate proved to be far too much. The quantity of nitrate in the interior on the Continent is understood to be about the same as that at the end of 1912; but there will be a larger supply of atmospheric nitrogenous products to deal with. In view of all this, and in order to make sure of their own market, producers of sulphate of ammonia in Germany reduced their prices substantially in November, both for prompt and forward delivery; and in order to make sure of a sufficient outlet for their larger supply, German producers have since November been competing more keenly in foreign markets. There can be no hope, therefore, of any increased demand for British production from the Continent, or, so far as we can see, for a demand equal to that over the spring months of the present year.

The outlook in the United States is far more promising, though the recent invasion of the market for the Southern ports by German producers has had a demoralizing effect. Pending authoritative information as to this year's cotton crop, buyers of sulphate of ammonia were very chary about operating ahead, but since they have been assured of a short crop, they have bought heavily and for delivery well into 1914. The price of cotton having again reached a famine level, there is every reason for fertilizing the next crop on the most liberal scale; and it has to be noted that the heaviest purchases of sulphate of ammonia for the United States have been made for cotton ports. It is fairly certain, therefore, that the United States may be looked to with confidence to provide a much better outlet for sulphate of ammonia than they provided during the spring months of the present year.

While prices in the United Kingdom were inflated, Germany took occasion to invade the Java market, shipping direct thereto in the first

four months of the year upwards of 11,000 tons, against none in the corresponding months of 1912. Since March, shipments from the United Kingdom in the same direction have been quite satisfactory; a shrinkage at the end of the month of 3072 tons having been converted into an increase of 4492 tons at the end of the year. But it is easy to see what an important difference it would have made to the market at a critical time had the orders for the 11,000 tons been placed in the United Kingdom. With the exception of Mauritius, there has been an increase in shipments to all of the sugar-growing Colonies; and if the larger shipments from Germany are added to those from the United Kingdom, it will be seen that there has been a very healthy expansion in the use of sulphate of ammonia for the purpose of sugar-cane growing, notwithstanding the low level of prices current for sugar.

Having regard to the larger visible supply of nitrate of soda, notwithstanding the combination to restrict output, to which we have already referred, and having regard to the larger supply of sulphate of ammonia both in Germany and in the United Kingdom, we cannot take a very sanguine view of the market over the coming season. Sulphate of ammonia is relatively the cheaper article; but last season it was relatively very much cheaper right up to June. There was then every reason for substituting sulphate of ammonia for nitrate of soda wherever and as far as practicable; and to this extent it was substituted. There is not the same strong reason now for going on with the substitution; but sulphate producers may be depended upon to stick to the ground they won last season, and to mend their grip as far as possible.

We see no prospect of expansion in the demand for Spain or for Italy. We fear that Japan has almost covered her requirements, and that there may be a shrinkage in shipments in that direction over the near months. If Germany can keep off the market for the sugar-growing colonies, this will provide a larger, and very acceptable, outlet for British production. We, however, look with most confidence to the United States; and if our expectations are realized, we think that the increased output in the United Kingdom may be required, though, in the face of the easier market in the forward position at the close of the year, buyers may be disposed to postpone their further purchasing. We do not, however, see that a higher level of prices is probable.

The Course of the Market.

The "Review" concludes with the usual record of the course of the market month by month; and this is followed by the customary tabulated statistics. One table contains the comparative weekly prices of sulphate of ammonia and nitrate of soda last year. In the week ending Jan. 4, sulphate was £14 6s. 3d., and nitrate £11 10s. per ton; on April 5, the prices were £13 18s. 9d. and £12; on July 5, they were £12 6s. 3d. and £10 12s. 6d.; on Sept. 6, £13 8s. 9d. and £10 15s.; and on Dec. 27, £12 16s. 3d. and £10 10s. respectively. Another table shows the average prices per cwt. of 95 per cent. nitrate of soda, in Liverpool, for the past ten years. They are as follows; 1904, 10s. 2¼d.; 1905, 10s. 9½d.; 1906, 11s. 4d.; 1907, 11s. 2d.; 1908, 10s. 2½d.; 1909, 9s. 9d.; 1910, 9s. 4½d.; 1911, 9s. 10⅜d.; 1912, 11s. 1d.; and 1913, 11s. 1d. The third table gives the average prices per ton of good grey (24 per cent.) sulphate f.o.b. Hull; the figures ranging over 47 years—1867 to 1913. The following are the averages for the past ten years: 1904, £12 3s. 8d.; 1905, £12 10s. 9d.; 1906, £12 0s. 9d.; 1907, £11 15s. 8d.; 1908, £11 12s.; 1909, £11 5s.; 1910, £12 3s. 2d.; 1911, £13 15s. 3d.; 1912, £14 7s. 9d.; and 1913, £13 7s. 8d.

THE HAMMERSMITH BOROUGH COUNCIL AND THE BRENTFORD GAS BILL.

Bill to be Opposed.

At the Meeting of the Hammersmith Borough Council last Wednesday, a report was submitted by the Law and Parliamentary Committee on the Bill promoted by the Brentford Gas Company to enable them (*inter alia*) to acquire a considerable area of land in the parish of Chiswick, and to make application for a Provisional Order authorizing them to generate and supply electricity. The Committee pointed out that the Company seek power to obtain possession, by agreement, of any authorized electric light undertaking, and also to supply "power gas," and charge for it such sums as may be agreed upon. The Company, however, are precluded from supplying this gas for the purpose of illumination. The Committee consider that the interests and probably the amenities of the borough will be greatly affected if the Bill passes. The Town Clerk had made a report upon the subject, which the Committee had had before them and considered. It set forth more particularly the manner in which the proposals of the Company might prove inimical to the interests of the borough. The Committee expressed the opinion—and they were informed that it was shared by the Electricity Committee—that the Bill should be strongly opposed, especially having regard to the competitive powers which it would confer upon the promoters. They accordingly recommended that steps should be taken for insertions in or amendments of the Bill, for the preservation and protection of the interests of the borough, in accordance with the particulars set forth in the report of the Town Clerk, and that the Council should present a petition against the measure in either or both Houses of Parliament. The report of the Committee was approved without any comment.

We learn that the Bill was fully discussed at a joint meeting of the two Committees named, and that the view expressed was that, as its provisions might conflict in various ways with the interests of the municipal electricity supply undertaking, which has involved an expenditure of a quarter-of-a-million sterling, the measure should be strenuously opposed.

At a meeting of the Management Committee of Co. Tyrone Public Hospital, Omagh, a proposal to have the gas fittings and connections in the institution removed was strongly disapproved of. The members were impressed by the fact that, if the electric light accidentally failed, the hospital would be left in darkness.

BRIDGE OF ALLAN GAS-WORKS ARBITRATION.

Further evidence was heard on behalf of the Town Council in the above arbitration, at the Caledonian Hotel, Edinburgh. Reports of the earlier proceedings were given in the numbers of the "Journal" for Dec. 30 (p. 1025), and Jan. 6 (p. 37).

The Arbiter for the Gas Company was Mr. Alexander Yuill, Gas Manager, Dundee, and for the Council Mr. R. Cockburn Millar, C.A., of Edinburgh, with Sheriff John Wilson, K.C., as Oversman. Counsel for the Company were Mr. F. T. Cooper, K.C., and Mr. J. B. Paton, Advocate, who were instructed by Messrs. A. & J. Jenkins, Solicitors, Stirling, and Messrs. Maxwell, Gill, and Pringle, W.S., of Edinburgh; and on behalf of the Council, Mr. J. Avon Clyde, K.C., M.P., appeared alone, instructed by Mr. A. Morrison, Solicitor, of Bridge of Allan. The Clerk to the reference was Mr. Dobbie, of Stirling.

Mr. *Walter Nelson* was further cross-examined as to his entry for bad debts, which he allowed had been taken on the basis of the average of six years, as the accounts showed no bad debts for the last year. Counsel asked if it would not have been reasonable for him also to have taken the average of the last six years for the profit. It was shown that witness proposed to make the figure for bad debts and reductions from £5 6s. 5d. into £10 12s. 7d.—practically 100 per cent. addition. Asked if it was reasonable to offer to pay the Company only 16 years' purchase of a profit which had been justifiable for the last 20 years, witness said he considered the equivalent money value that could be obtained in equally good first-class stocks would be correct. He could not say whether the property of the various gas companies to which he had referred for fixing the value was freehold or leasehold, nor could he speak to the circumstances of the companies, beyond what he had learned from the stock list. He agreed that he was taking his figures from the "Journal of Gas Lighting" for Dec. 16, 1913, and was asked regarding a number of other concerns not referred to on his list. He could not give any instances of Scottish gas companies, and there were not many transactions in shares, probably owing to local conditions. He agreed that he was proposing to pay the Bridge of Allan shareholders a sum of money which, if invested by them, would not give them what they are getting at the present time. The actual capital expenditure was £20,433; while he proposed to pay the Company £19,196, as he thought there was a question of doubt as to whether the cost was justified. He did not think the Company had a goodwill, as it was a non-statutory concern. He did not admit that this was a case of a willing buyer and a willing seller. Asked if he could say how, if the seller were unwilling, he could account for his selling, witness said he supposed he preferred to sell rather than to have any competition set up. He could not recollect any case of a compulsory purchase where the price fixed had been less than the bricks and mortar to be transferred, and without anything for goodwill, when a handsome profit had been made. Witness then put in a table showing transactions in shares of the Bridge of Allan Company during the years 1908 to 1912, after allowing for accrued dividend, on the dates of transfer; the averages being £6 0s. 4½d. for the former year and £6 5s. 7d. for the latter year.

Mr. *W. R. Herring* then gave evidence. Structurally, he considered the Company's property, with one or two exceptions, was in a fair state of normal repair for such concerns. One exception was the settlement of the foundations of the retort-house and bench. The bench had gone down fairly level for 6 inches. Producing photographs of cracks in the north-east wall, he said he considered the cracks were extending, and was not surprised when he heard, that morning, that the site had been a brick-works and clay-field. He considered the corner must be underpinned. He also produced photographs of the marks on the chimney where it had been pointed. He thought the chimney would have to have 10 or 12 belts round it; and this should be done at once. He had seen holes in the corrugated iron roof. He considered the best evidence regarding the state of the pipes was the leakage account. The amount spent was altogether insufficient to maintain the works. The new erections involved a capital outlay of £17,001 17s 3d.; while the engineer's detailed estimate was £11,672. On the capital and borrowed money, the average percentage worked out at 8, which had to come out of the consumers' pockets by a high relative price of gas. This equalled 15·24d. per 1000 cubic feet sold. The effect of the new works had been to raise the price of gas 5·26d. to the consumer. He compared the amount required for interest at Bridge of Allan with Stirling, showing 10·8d.; Burntisland, 8·64d.; Arbroath, 6·54d.; Dunfermline, 10·17d. He had estimated the cost of the works himself as at 1902 at £12,325. He used the factor of £300 per million cubic feet of annual production for works such as these; land being extra. Taking the works at 40 millions, costing £17,000, it was £425 per million. This was excessive. His £12,000 did not include land nor houses. There was no possibility of the excess plant becoming a productive agent within the next 25 years. He put in a table comparing the price at Bridge of Allan with other towns, showing a falling price generally. He found from the minutes that the make of gas had increased 28 per cent. during the previous five years to 1899, and during the three years to 1902 a further increase of 21 per cent. This was an increased consumption per consumer rather than an increase in new consumers. On the date available up to 1902, the construction of works of 40 million cubic feet capacity was not justified. Bridge of Allan had to retain its price in order to pay interest on its capital expenditure. The locality he would call saturated. There was not any prospect for an increase of either gas-fires or cookers at the price of 3s. 6d. per 1000; and in view of this he thought the excess had no value, but rather the reverse, because it required some expenditure maintained on it. He considered that 16,199,000 out of the 40,000,000 cubic feet were unavailable. Taking this at his figure of £300, it came to £4800 as the gross sum; and he thought, according to the usual methods, this should be reduced to £3241. If there was a prospect of using it within the next ten years, this is what he thought they should pay; and if there was no prospect, he saw no reason for making an allowance at all.

By the Arbiter: He did not think that the excess plant had any

tendency in this case to reduce the cost of practical working. The maximum day's make was the factor on which to calculate, and usually a bit more was allowed. He had included the manager's house and allowances as part of the expense of making the gas. The workmen's houses he considered in the same position as the manager's house—namely, part of the undertaking. The surplus land was also treated as part of the undertaking and went into the rents. If it had to be valued separately, it should come out of the calculation of the maintainable profit. He was responsible for the 7½d. per 1000 cubic feet claimed for expenditure on repairs to works, mains, and meters; but this did not include cookers. These were dealt with separately, and the figure for them was 2·16d. The average for leakage was about 5 per cent.; but it was 16 per cent. in Bridge of Allan. He considered 7½d. the figure commonly required if the works were to be efficiently maintained. As he could find no documents showing any right to the water from the burn, he made provision by taking £30 from the maintainable profit for water supply. He had allowed the Company three years' purchase on the profit on sale of fittings, as it was not reasonable to treat these on the same basis as the supply of gas. He had heard 26⅔ and 25 years' purchase claimed by the Company's witnesses. There was no such thing as a customary value. He had taken out the six companies which were giving at or about 12 per cent., and had thus brought out the figure of 18½ years' purchase. He considered the difference between a statutory and a non-statutory company was three years, but had taken the figure of 2½ years and had added the half-years' purchase for any difficulty in re-investment. In his opinion, the figure he had given (£18,196 19s. 3d.) was a fair equivalent for what the Company had to give. When he thought the leakage was only 10 per cent. and the water supply secure, he had made his valuation £26,227. He had not then made the reduction of three years for a non-statutory company, as it was with a view to purchase by agreement. This meant a difference of about £4500. He thought the offer of £26,000 was made to avoid proceedings, and was an exceedingly generous one.

Cross-examined by Mr. COOPER: He first visited Bridge of Allan about the end of last May and had made three visits in all. The water was one of the factors reducing his present valuation. There was some discussion with the Oversman and Mr. Clyde as to the making of the valuation on the value of the undertaking to the Company; and Mr. Clyde maintained that they must have something to sell, and there was no title to this water, although there might be prescription to some. In preparing his first valuation, he had valued the surplus land separately at 25 years' purchase at £27, and had made no allowance for compulsory purchase. The figure for maintainable profit he had taken from the Company's balance sheets. After allowing for back income-tax, this brought the figure to £1540. He had no material to know how much of the leakage was due to mains or to service-pipes or to meters. He was aware the service-pipes were not the property of the Company. The works were not materially defective. He had not considered whether the Town Council were getting a "white elephant" or not. The undertaking was a desirable possession for the Council, because in a matter of 20 years hence the effect of the sinking fund would be felt. He could not speak to any place where the price of gas had gone down immediately after purchase. It was a common way to judge the condition of mains, &c., by looking at the percentage of unaccounted-for gas, which was an indication. He considered the leakage was principally at the meters, service-pipes, and connections to the main. He was not prepared to allow that Bridge of Allan had a moderate leakage compared with other towns in Scotland. He was given figures of certain towns where it was greater per mile of main than in Bridge of Allan. Witness could not accept this method of testing leakage. Asked why he could not accept it, he said he did not know. He could not see that the percentage of leakage went down with the gas made. He thought Mr. Yuill had taken in his estimate all the items of expenditure necessary to construct the works. He agreed there was no item for excavation in the estimate, and that this had cost over £2000, nor were workmen's and manager's houses (£2079) included, nor was there an item for architect's fees. There was no boiler mentioned, nor was fencing provided for. There was no estimate for land. He suggested that the architect's fees would come out of the sum of £562 for contingencies, and he agreed that the architect's charges amounted to £691. He admitted that the price of gas had gone down the year the new works were opened. Had their old works been reconstructed, the Company might have done better, and also the price lowered more. He had recommended reconstructing the old works instead of putting up new. He was consulted regarding the Kirkcaldy case, and had recommended reconstruction there; and he had also reconstructed the Huddersfield works on the old site. Asked if he had recommended that the works at Kirkcaldy should be doubled, he said it might be, but he was not sure.

By the ARBITER: Capital per million on the make at Edinburgh was £1080; if annuities were not there, it would be something larger.

By Mr. COOPER: It was shown as over £1000 in Field's analysis. The cost at Granton had been about £200 per million of annual make, but £300 per million was applicable to the smaller works at Bridge of Allan. Deducting the cost of the workmen's and manager's houses from the amount shown as cost of works in statement "F," it came out at £398 per million. His £300 did not necessarily allow for mains outside the works, and these pipes cost £900, which would reduce the amount by a further £200 (making £376). Referring to his table No. I., he agreed that the larger the number of consumers the cheaper the gas could be made, and, taken over several places where the price had dropped, he agreed that certain of his figures had been taken from the "despised" North British Association of Gas Managers' publication. He did not know that there was a colliery close alongside the gas-works at Berwick-on-Tweed, where the price had only been reduced 1d. in eleven years, as compared with 6d. in Bridge of Allan. In Broughty Ferry he agreed that the price had risen 2d. At Burntisland there had been a sudden reduction in the price of 5d., that might be due to the operation of a sinking fund. Dunfermline was also above a coalfield, and there a sinking fund operates; and the same considerations apply to Falkirk. He would not be surprised that all towns of the same size as Bridge of Allan had high capital charges. There was practically no hope for the future of the Bridge of Allan Gas-Works unless the circumstances changed. On the question of a higher gas output, Messrs. Gillespie and Yuill were justified in 1899, and still more justified in 1903, in urging larger works to be erected. Knowing all the factors, he did not consider there was justification for building new works. He agreed that buildings had risen from 721 to 743 in 1905, consumption had increased, and customers had increased by nearly 200 slot consumers. He would not have advised the change from the old to the new works. He did not know what would have been the cost of the site at the old works for extension, but suggested that the Gas Company was past the heyday of its fortunes. When a business becomes stationary, it begins to go back. Asked if he gathered this from the statistics of the Irish gas-works, he admitted it was a little illogical. He had not told the Town Council the seriousness of competition by electricity, and they had not asked him. He agreed that he differed by about £2700 from Mr. O'Connor's and Mr. MacPherson's valuations of excess plant. He had taken the excess capacity at 16,199,000 cubic feet, but had not taken out the excess capacity of the various buildings on exactly parallel lines with Mr. O'Connor. He considered 7½d. per 1000 cubic feet the proper figure to allow for expenditure upon repairs. He had taken 7·72d., and allowed a farthing for the service-pipes. This he thought quite enough, although he agreed that the leakage mainly occurred at the joints. His position was that it required 7¾d. in a properly maintained gas undertaking, apart from stoves, and a farthing of this might be fairly said to represent the repair of service-pipes. He looked upon the expenditure of 1d. to 1¼d. per 1000 cubic feet as nominal expenditure upon the repair of mains. His 7½d. was composed of 4·38d. for the works, 2·01d. for pipes, and 1·33d. for meters; he had taken the 1d. from another book. The list he had taken included 53 English and Scottish gas companies. Asked if he had read a paper on working costs, in which he said that repairs and maintenance of Scottish gas-works were carried out at considerably less cost than in England, and that the average cost for Edinburgh and Glasgow was 2·74d. against 4·75d. for London, he did not remember what he had said. Taking the Metropolitan gas companies and the English provincial ones, the figure was 3·86d. He had said that it was not an unknown thing, in valuing gas-works for purchase, to deduct from available profits the equivalent of 4d. or 4½d. per 1000 cubic feet. He did not tell them about the 7¾d. in 1905 because the costs now are greater. He did not dispute the figure of 5·065d. for maintenance of works, pipes, and meters for fifteen named corporations and one company. Witness instanced Stirling, where the total was 10·46d. He could not account for this enormous increase over other companies in Scotland, unless he had a chance of handling their figures, as 7¾d. was the average for an overhead view of the cost. Of the 53 works he had taken, only one was a Scottish company. The replacement of cooker parts, worn out and twisted, he thought would cost 2d. per 1000 cubic feet. The cost of stove repairs in Edinburgh was 1·12d., which was higher than the average of English towns, where it was 0·97d. The cost for corporations was 0·44d., and in Glasgow 0·64d. He had nothing to do with the preparing of the statutory accounts for Edinburgh, which were made out in the accountant's offices. He could not show a separate heading for replacement of stoves in these accounts. He allowed three years' purchase on the fittings, because he was dealing with a standing district, and the people had got all their furnishings. It was too risky a trade to be worth capitalizing on a higher basis than three years. The witness was then taken through Table A.M. III., showing the price of gas and the percentage of cookers to customers, and, in all the places shown, the price was higher than in Bridge of Allan; but witness did not know these facts. In his own experience, he would say that 18½ years was as low as had occurred. He suggested that a 16 years' purchase of the diminishing maintainable profit would enable shareholders to invest their money as well as at present. He had not seen the notice of the award at Ashbourne in the "JOURNAL OF GAS LIGHTING," and did not know that the award worked out at £1371 per million cubic feet.

In re-examination, witness said the average of the three Scottish companies transferred since 1900 came out at £896 per million, which would give the figure for Bridge of Allan at £19,594.

In reply to Mr. COCKBURN MILLAR, he considered the Burgh Gas Supply Act included the accounts due to the company, the coal, tar, pipes, cookers, cash, &c.; and if the town had to pay 3¾ per cent., it would cost them £720 a year in interest and £480 for sinking fund on the basis of his valuation. He considered that normal stocks were covered by the capital that is paid for in the profits; but where there is anything abnormal, it required consideration.

SPEECHES OF COUNSEL.

The fifth day was given over to the speeches of Counsel.

Mr. COOPER pointed out there were two subjects to value—first the undertaking, and second the value of stocks of coal, lime, and meters in hand. He was surprised at the way the case was represented by witnesses for the respondents, because one wondered how any Town Council, however insane, could ever have resolved to go forward in this case. It was agreed on both sides that the new works cost £17,001. He did not think the Town Council would spend a farthing for repairs on the retort-house, chimney, or tar-tank. He did not consider that the tribunal could settle whether there was a title or not to the supply of water, and he thought they must take it on the basis that they had such a supply, worth at least £30 a year to the undertaking. He referred to the criticism by the other side of Mr. MacPherson's table of percentage of leakage, and the fact that their figures, from the Board of Trade returns, gave them all much higher than his tables had shown, while Mr. O'Connor's table showed that Bridge of Allan had only about the normal leakage among gas companies and corporations in Scotland. As regarded the price charged for gas, he referred to the table of Mr. MacPherson and that of Mr. Napier, and to the fact that Bridge of Allan made no charge for cookers, nor any extra charge for the use of a prepayment meter. In any case, the Town Council were depriving the Company of the right to earn the dividend of which they had been the recipients for many years, and it was not for them to come now and say: You have been charging too much and making too much money. He pointed out that Mr. Yuill's report expressly excluded the houses, and that when these were added to his estimate, it came to £13,800, instead of £17,000 actual cost. There was a rise in the number of

occupied houses, a rise in the resident population, and there was no justification for a gloomy view of the prospects of Bridge of Allan. He referred to the small number of tables put in by the Council's witnesses. He said that first it must be ascertained what was the value of the concern as manufacturers and sellers of gas, then as sellers of heating apparatus and appliances, and then, further, the value of the property outside the works. He considered that Mr. Gowan's statement "I," as altered by Mr. Nelson, was made with the object of diminishing, as far as possible, the maintainable profit; and he went through each of the items, comparing them with the original statement. The other side had included the rents of house and fields, under the revenue of the gas undertaking, to avoid the separate valuation by the tribunal of the surplus land and houses. He claimed that the income-tax should not have been included, as it was only a tax after profits had been ascertained, and was not an item included in the schedule of the Gas Act of 1871. The next point he objected to was the figure of £50 inserted as an allowance for replacement of cookers, which he claimed was a separate business, and not part of the manufacture of gas. Although the Company had not claimed their cookers as an asset at all, the other side suggested that there should be a deduction of £50 for depreciation upon what had not been treated as an asset. He compared Mr. MacPherson's and Mr. O'Connor's valuation with Mr. Nelson's, and there was only a difference of £10 in the maintainable profits between them; and, going through each item of difference in the treatment of the maintainable profit, he specially referred to the difference between the 4½d. for repairs claimed by the Company's witnesses, and the 7½d. quoted by Mr. Herring, who had taken 53 undertakings, of which only one was Scottish. He referred to Mr. Herring's paper in 1905, a copy of which the Oversman asked should be put into process, and Mr. Cooper read several excerpts from the paper where the lower figure in Scotland as compared with England was referred to; and Counsel maintained that 4½d. was the correct figure for maintenance in Scotland. The amount of deduction for money not expended on repairs and maintenance, he suggested, should be £143, against £336 proposed by the other side, and the question of the water was not a matter that could be deducted from the maintainable profit. If a purchaser allowed anyone to bounce him out of the right to it, so much the worse for him. The Town Council, however, had been in possession since February, and had been getting water all the time; and therefore he could not see why anything should be deducted under this head from the maintainable profit. The evidence regarding the valuation of the land had been uncontradicted, and also as to the manager's and workmen's houses. He agreed that the manager's house, and the rent of it, had to go into the revenue account, and, from Mr. Marwick's valuation, this was worth from £600 to £700. Requested by the Oversman to debate the point of the excess works as if it were a critical point, and referred to the question of purchasing on the footing of maintainable profit and a structural valuation for a portion of the works, Counsel pointed out that the maintainable profit was earned by only a portion of the works, and that the balance was valuable when any increased demand came forward. There had been no counter-evidence as to the value of excess property, spoken to by Mr. O'Connor, which the Oversman agreed had been very carefully done. Mr. Cooper pointed out that, as far as the maintainable profits were concerned, the works might have been made larger than at present required; but when a large increase arose, capital would have to be spent on the additions, and it was this additional capital that he was asking should be paid for. The gas-works were able to supply a very much greater demand and earn a much larger maintainable profit when the increased consumption arose, without a single farthing of capital expenditure. This was an asset to the Company over and above the maintainable profit which must be paid for by the Town Council, who were to reap the benefit of it. It was absolutely absurd to suggest that there was no prospect in the future for Bridge of Allan, and that the value of the excess was what had been put in as the value by Mr. O'Connor. He was told that in the Dunfermline arbitration the respondents' engineer conceded the addition for value of excess works at £3760. Similar claims were made in the Kirkcaldy arbitration. Mr. Cooper spoke to the question of the number of years' purchase. He did not consider it was a satisfactory way to refer to English gas companies, and remarked on the common belief that the higher the return obtained for shares, the less safe they are. He thought the proper way was to look at the steady dividend of 12 per cent. which the claimants had received for so many years. The figure of 16 years' purchase of the respondents was a ridiculous one. It gave a total value of £19,196, out of which the Company would have to pay the £9000 borrowed; leaving merely £10,000, which, when divided, would show only £3 per share for the £2 10s. shares, whereas the lowest figure found by Mr. Nelson in recent years was £6 5s. He reminded the tribunal that an offer of £26,000 had been made. As to the stocks in hand, he pointed out that a company selling their works would, if the stocks were not to be paid for separately, see that they had not an ounce of coal, lime, or anything else, as they would get the same price as if they had 1000 tons of coal. The Town Council's original offer did not include the value of stocks of coal, lime, or other materials. As to the 10 per cent. for compulsory sale, he referred to the gentleman of the road, who said: "Your money or your life." If one replied: "You can take my life," then the highwaymen got the life and the money, too; but if, on the other hand, the purse was yielded up, that was lost, but the life was preserved.

Mr. CLYDE, in his speech for the respondents, said that the principles upon which the valuation of such an undertaking should be made were well recognized as based on the profit which it was reasonably expected could be derived from the undertaking in the course of the immediate tract of future time after the purchase was effected. He claimed that the wording in the Burghs Gas Supply Act of 1876 meant everything which the Company owned; but Mr. Cooper pointed out that the offer of the Town Council was for the undertaking, and all the rights, powers, privileges, and the lands, premises, works, and other property of the Company. Mr. Clyde claimed that he was to purchase not a naked works, but a sufficient quantity of coals, &c., to carry on the concern, which was being purchased on the basis of maintainable profit. If there was at the time of transfer a large stock of coals, in view of a strike (say), he would not claim that.

By the OVERSMAN: Might not the purchase price be fixed on the basis of maintainable profit and also a structural valuation?

Mr. CLYDE: Yes; and supposing you had four times the amount of plant you required, it is plain that a considerable part of the plant was not truly part of the undertaking at all. Continuing, he said he had been in all the contested cases of gas companies since Falkirk, and the companies had had to pay for the water they used. He had not dreamt that he would be asked to pay for the water supply as an item of value. The Company had produced no title to it whatever. His view was, therefore, that it must be treated as a deduction from the costs.

The OVERSMAN pointed out that the Company had never paid for this in the past.

Mr. CLYDE held that the future was precarious. In considering what was maintainable in the future, it should be cut down to legal rights. Coming to the question of the amount spent upon repairs and maintenance, he said the sum spent by the Company had been only 2½d, which the Company proposed to make up to 5½d. He thought it should be 7½d.; and this was proved by the anxiety of their witnesses to attribute the unaccounted-for gas to anything except the cause to which it was naturally attributable. This was always stated by gas engineers as a percentage of the make. The broad fact was that this Company and part of the distributing system had existed for seventy years. The works had been built upon a foundation so bad that the retorts had sunk 6 inches, and the chimney and retort-house had also been cracked. This was a serious business; and they could hardly ask him to treat the undertaking on better terms than good first-class companies. His friend was asking to have the works treated upon the full basis of a works kept up on the highest plane of repair, &c., and for the full number of years' purchase. He asked for 7½d. to bring them up to the fair average. He thought three years' purchase for the profits on the sale of fittings was enough. There was no monopoly in selling globes, mantles, and fittings. He left himself in the hands of the tribunal as regards the amount put in by his witnesses for bad debts and deductions. He had allowed nothing for surplus plant; and the price he was being asked to pay included the interest on this capital, for which he was to pay again. The interest had been earned and paid for by keeping the price of gas at 3s. 6d. He was being asked to pay for this twice over, because it had been a dead-load, not on the Company, but on the consumer. If the Company could show, with reasonable probability, that within the current year's working they could get not only their 12 per cent., but a lot of additional profit besides, then they could ask for more; if not, then the excess plant became a white elephant. The point about his figures as to the chance of increase was what happened between the starting of the new works in 1906 and 1913; and neither sales nor consumption was going up. It was said that there was a great future for cookers in Bridge of Allan. The Company had been following the advice given them in 1899; so that this department had received attention for the last 13 years. It could not be anticipated that, with a price of 3s. 6d., a large development could be expected in this direction. The excess plant had been a misjudged expenditure of money. The houses at the works were all in a row, and were not lettable property. He submitted that they were part and parcel of the gas undertaking. If they were to be valued as lettable property, then only five or ten years should be allowed. As regards the land, if this was to be valued separately, then the rent must be deducted from the maintainable profit, and the value of the land would be the rent received less the burdens; and this capitalized would be £400. Mr. Cooper claimed 25 years' purchase on the basis of a guaranteed annuity; but on a basis of maintainable profit the value of money could not be ignored. Taking the price of the shares at £6 5s., with a 12 per cent. dividend free of income-tax it became 12½ per cent., then the dividend became one of 5 per cent. only. On this basis one would have 20 years' purchase; but the best way of getting the equivalent in money was the value of money invested in shares of the best class, and then one had a figure about 18½, as they stated.

The OVERSMAN asked if it was quite fair, after disturbing the Company, to estimate the money value on the footing that they are to put their money into a similar kind of investment.

Mr. CLYDE claimed that his figure of 18½ years' purchase, reducible by 2½, was the exact figure.

The OVERSMAN asked the difference between a statutory and a non-statutory company.

Mr. CLYDE replied that a non-statutory company had something approaching a monopoly, but no legal monopoly, and that a statutory company was placed under certain restrictions with reference to its management and control, which makes for financial stability.

The OVERSMAN: A non-statutory company will never be ousted by Parliament, without being bought out. I have the feeling from my experience that now-a-days a non statutory company is regarded as practically as secure in a question with competitors.

Mr. CLYDE: If the non-statutory company goes to Parliament, it is put under very awkward restrictions with regard to loan capital.

The ARBITER pointed out that, in the case of Lurgan, the arbiters gave a decision of a certain sum if statutory and a larger amount if non-statutory; so that they had a deduction of 2½ years in England and an increase in Ireland, and therefore they stood in Scotland as the mean.

Mr. CLYDE said that 10 per cent. was always asked for compulsory purchase and never given. What he proposed was half a year's dividend. Taking the average of the three Scottish non-statutory companies which had changed hands since 1900, it worked out at £896 per million. Then the valuation there would be £19,549.

Mr. COOPER, called upon by the Oversman, said that the admission that there had not been sufficient allowed for repairs and maintenance referred to the last year only, and was admittedly upon the worst of the last six years. If this deduction was made upon the one year on which the maintainable profit was being calculated, it also referred to any other year if the profit had been taken over a number of years. If the Company had not had the large capital referred to by Mr. Clyde, they could have paid a higher dividend.

The proceedings then terminated. The terms of the award by the Oversman appear on p. 141.

THE STRIKE AT BLACKBURN.

A Deadlock—Improvement in the Gas Supply.

Efforts were made throughout last week to arrange a special conference between the representatives of the National Union of Gas Workers and General Labourers' on the one hand and representatives of the Blackburn Corporation on the other, respecting the differences which have arisen affecting from 350 to 400 workmen employed by the Corporation; but, at the moment of writing, it appears that the unfortunate strike must enter on its fourth week on Wednesday (to-morrow). It was generally expected that some arrangement would have been arrived at during the past few days; but surprise and regret were expressed on Friday night when the Mayor (Alderman Higginson, J.P.) came to the conclusion that no good purpose would be served by extending the representation of the Special Conference Sub-Committee. The official statement, issued by the Town Clerk (Mr. Lewis Beard), was as follows: "The Mayor has very carefully considered the questions in dispute between the Gas Workers and General Labourers' Union and the Corporation, and he has been in consultation both with Mr. J. R. Clynes, M.P. (the Lancashire District Secretary), and representatives of the Corporation. He regrets that the differences are so acute that he cannot see his way at present to summon any conference, as no practical result could be arrived at."

STATEMENT BY THE CORPORATION.

Subsequently there was a meeting of the Special Committee of the Corporation appointed to deal with emergencies, consisting of the Mayor, Alderman Nuttall (the Vice-Chairman of the Electricity Committee), Alderman Watson, Councillor J. R. Hartley (the Chairman of the Gas Committee), and Councillors Fielding and Shorrock. After quoting from various speeches made by Mr. J. R. Clynes, M.P., during the strike, the Committee made the following submissions on behalf of the Corporation:—

1.—The Corporation pay their outdoor able-bodied labourers a minimum of 6d. per hour. This is not "the rate which is now being paid by private employers for the lowest-graded class of general labouring work." [The quotation is from one of Mr. Clynes' speeches.] General labourers in the foundries and engineering trades are paid substantially less.

2.—The Corporation have never put forward the contention that "the lowest wage arranged by the private contractor should be the standard wage for the Corporation employees," nor that "municipal servants should have the lowest of the rates agreed upon by the union for labourers." The contention of the Corporation is that where the union and the employers have agreed upon a rate for a certain class of labour, the Corporation should pay the same rate for this class. This principle has always been recognized in the case of skilled labourers—*i.e.*, joiners, plumbers, &c.—and the Corporation do not see any reason why it should not apply to labourers. The Corporation labourers are divided into different classes, as private employers' labourers are, and where the private employer pays 6½d. to 7d. per hour, the Corporation pay these rates. Many of the men now applying for an advance are already getting these rates.

3.—It has been pointed out, on behalf of the men, that many of the labourers make broken time, especially in winter. This the Corporation have shown their willingness to meet by the proposed 1s. per week during the four winter months; and it should be observed that an advance in the rate per hour is not adapted to meet this difficulty, as a man's pay would still be cut-down by his broken time, while the 1s. per week is unaffected.

4.—The Corporation have shown their willingness to meet the men on the only lines that appear to them to be open—viz., the consideration of the special conditions upon which the men work and any hardships they may suffer. But the Union refuse to meet the Corporation on these lines, and insist upon their demand for a hard-and-fast ½d. per hour for the men now paid 6d., and advances to men receiving higher rates, which now go up to 7½d. [This is, in substance, the original demand for a minimum of 6½d. per hour put forward in Mr. Fleming Eccles's communication of Aug. 22 last.]

5.—The Corporation are trustees of the ratepayers' money, and it is their duty to be careful in the expenditure, especially having regard to the fact that many of the ratepayers belong to the working class.

REMARKS ON THE POSITION.

Whether the struggle between the Union and the Corporation will be of a determined or protracted character remains to be seen

It is not regarded as in the slightest degree likely that the strikers will be invited to return. In one quarter our Manchester Correspondent learned that steps would be taken before long permanently to fill the vacancies caused by the strike in the different departments of the Corporation service; but no official confirmation of this was obtainable. Another informant declared that more men were to be introduced from Leeds and Manchester; but a Union official waxed eloquent in pointing out that the dispute was not entered upon lightheartedly, but with a full sense of the responsibility involved. When told that another rumour was that the strikers would be given a "last chance" of returning to work, one of the many pickets declared that the strikers were sincere in their demands, and would not go in until they were conceded.

Our report of last week stated that "conversations" would take place at an early date between Mr. Clynes and the representatives of the Corporation. These "conversations" concluded on Tuesday afternoon; their purpose being to settle, if possible, what suggestions should be placed before the Special Committee for the final settlement of the dispute. The result was a *fiasco;* and at the conclusion the Town Clerk, in an official statement, said: "The preliminary conversations between the Mayor, Alderman Nuttall, and Mr. Clynes have now been completed. No settlement has been arrived at, but negotiations are still proceeding. The Mayor is considering the next step to be taken." The "next step," however, was the startling turn on Friday evening, when the Town Clerk issued the further statement which has precipitated a deadlock.

During the whole of the past week the gas supply for household purposes considerably improved; but thousands of pounds are being lost to the town every week in reduced wages, on account of the curtailment of the gas supply to mills and factories. Workshops, too, are idle after dusk, though it must be confessed that, except for the long lines of unilluminated street-lamps in the evenings, and the untidiness of the thoroughfares, the town presents very few evidences of the arrest of its services, which embrace almost all phases of Corporation enterprise. A serious question, however, confronts the Sanitary Department, for the removal of house and other refuse is greatly retarded; only a few men being available to cope with the work.

A SETTLEMENT AT LEEDS.

For all practical purposes (on the Corporation side), the strike at Leeds was killed some time ago; but its burial proved a tedious affair. "Artificial respiration" was tried; but it was of no avail. The strike would not come to life again—that is, other workers than the hopelessly defeated ones would not throw up their jobs. Time after time the men were told they were on the winning side, long after the fight was lost. But the truth had to come out at last; and some of the followers must have been sadly disappointed to find what sort of a "victory" it was to which they had been led.

On Monday of last week, Mr. J. R. Clynes, M.P., resumed his negotiations with the Special Committee of the Corporation, and an agreement was come to—for which fact due credit is given to the tact, firmness, and common sense of Mr. Clynes. Early next morning, in accordance with arrangement, Mr. Clynes met the strikers at a mass meeting, and reported to them the outcome of his interviews with the Special Committee. There was during the recital a little uncomplimentary interruption; but eventually the terms were recognized by the great majority of those present as all that could be expected. The terms on which the men are at liberty to apply for their old jobs were stated by the Special Committee as follows:—

1.—Where advances have been granted by the Council on Dec. 3, these will date from the time of re-starting work.

2.—With regard to cases where men have received no advances in 1913—(*a*) artizans, (*b*) non-able-bodied men, (*c*) able-bodied men whose work is not comparable with that of men engaged by private employers in Leeds—if any omission or grievance can be shown, the Committee will consider applications which are forwarded through the heads of departments when the men have returned to work.

3.—Re-instatement: (*a*) The Special Committee have instructed heads of departments to re-start, as early as possible, as many of the previous workmen who apply as can be effectively employed; and a considerable number of these will be started within a day or two. (*b*) These will be further augmented before the expiration of seven days by the addition of a further considerable number. (*c*) Thereafter, the Committee will not prejudice the chances of former workmen being re-started by engaging fresh men, unless essential to the needs of a particular case.

Four o'clock was fixed as the time when application for reinstatement had to be made; but there were early callers at the different departments, and later a continuous stream. Indeed, at five o'clock it was announced that practically the whole of the former employees had visited the Meadow Lane Gas-Works. There was plenty of evidence that they were only too pleased to take advantage of the permission to apply for reinstatement, and that they had no desire to call attention again to the erstwhile battle-cry of "All or nowt." The strike will convey many useful lessons to those who thoughtfully consider it. One point is that it will emphasize the advantages of labour-saving devices in connection especially with the supply of what are really necessities of modern town life. These are the new verticals, which were brought into use during the strike—a significant event—and now it appears that an increased application is being made of automatic lamp lighting. Another thing which has been demonstrated is the overwhelming power of the citizens in deciding such fights—when their toes are trodden upon sufficiently heavily to thoroughly rouse them. The men have been misguided all along; and after warfare of this kind, of course, things can never return to quite the same position that they were in before. But there will be general agreement with the following tribute paid them by the Lord Mayor of Leeds (Mr. E. A. Brotherton), when asked for his views on the settlement: "That the cloud which has so long hung over our city has at last been removed is a source of considerable satisfaction to me. The citizens owe a deep debt of gratitude to the Special Committee for their painstaking labours in dealing with an extremely difficult situation; and we should also recognize that the employees, as a body, have maintained a patient and orderly attitude under circumstances that must have been very trying to them. In my opinion, the lesson which we should try to learn from this unfortunate episode is that a strike is an uneconomic and unnecessary way of dealing with industrial disputes; and I trust that the time may soon arrive when Boards of Reference will be generally accepted all over the country, and that when similar disputes arise they will be remitted to such representative boards without demur on either side."

Shrewsbury Water Undertaking.—The Local Government Board have refused to grant the Shrewsbury Corporation a Provisional Order dealing with the water undertaking. It is understood that the objection of the Board arose out of their disapproval of the dual water supply in the borough. The Board had already expressed their opinion that the existence of two separate schemes was unsatisfactory; but it was hoped the Board would sanction the financing of the conduit supply out of the profits of the Severn supply, and the building-up of a reserve fund.

THE MANCHESTER COKE CONFERENCE.

By Robert Watson.

[From the January issue of the Bulletin of the British Commercial Gas Association.]

The large attendance at the Coke Conference held on the 16th of December in Manchester justified the action of the General Committee of the B.C.G.A. in convening a meeting of representatives of the gas undertakings lying in the Midland and Manchester District Institutions areas. The invitation was extended to chairmen, councillors, directors, and officials; and the conference not only served the purpose intended, but carried with it the suggestion that occasional district gatherings of this kind would have a distinct value.

Whatever the outcome of the resolutions passed, the general discussion was calculated to have a good moral and certainly stimulating effect in inducing all and sundry gas undertakings to take an active and enterprising interest in fair and businesslike methods of coke disposal.

Three important proposals resulted from the debate, and, on being put to the meeting, were agreed to without dissension. The first was virtually a request to the General Committee of the B.C.G.A. to continue the work started by them when they appointed a Sub-Committee "to consider ways and means for increasing the sale of coke," and to further this object by acting as agents for the collection of data of quantities and location of coke stocks for the information of subscribers generally. Whether the latter is practicable at the present juncture, in view of the many and varied activities of the B.C.G.A., is a matter for both the Executive and General Committees to consider, but the proposal will merit careful attention.

It need only be said, however, for the benefit of administrators of the gas undertakings who are not subscribers to a Commercial Section, that they can get all the required information at any time by making their manager a member of the section and instructing him to attend the monthly meetings And here comes in the value of the second resolution passed at the conference—viz., that every gas undertaking should become associated with its District Commercial Section. If this suggestion be generally adopted, good will accrue to the whole gas industry, but not the least gainer will be the joining undertaking itself.

It is the latter fact that has proved the strength of the section; for there can be no hesitation in saying that the small subscription necessary to cover working expenses is one of the best investments a gas undertaking can make. While information as to stocks and trend of prices of residuals is thus procurable, the hints and suggestions induced by knowledge of the practice and experiments made in other towns are frequently invaluable and as frequently acted upon. Many gas undertakings to-day are taking steps in the special preparation and local disposal of coke which they would not have done but for some neighbours' encouraging results discussed over the section table. Monetary benefits have followed, since an extra ½d. or 1d. per cwt. is easily obtained for, and does not hinder the sale of, broken or domestic coke.

The exchange of opinions and experiences at the Manchester Coke Conference afforded some indication of what gas undertakings may lose in this respect alone by abstention from section work.

The third resolution passed at the meeting was but a reiteration of the advice ever tended by those who have had experience of the work—that systematic local publicity and advocacy of coke as a household as well as trade fuel should be undertaken by all.

While varied phases of the coke question were discussed and from different points of view, probably the subject-matter of the third proposal was the most important, because of the possibilities of increased coke sales in the "home" district, and at remunerative prices. Strong arguments and examples in this connection were advanced by several speakers.

The testimony of an engineer of a large Yorkshire gas undertaking having collieries within its area, and possessing no outlet for coke in the way of carburetted water-gas plant, was remarkable. As a result of an evidently well-thought-out publicity campaign, he had succeeded in so augmenting his local trade that he found himself practically in the position of getting more orders each day for coke than could be conveniently handled; and the value of the advertising work was indicated by the statement that 60 per cent. of the orders were from those who had not previously used coke.

Another gentleman representing a purely residential town (where there were no industries requiring coke fuel) gave further evidence of what can be done by adopting publicity methods. The persistent hawking of coke—sale or no sale—through the streets of his town, had ultimately caused people to realize that there was such a fuel as household coke; and in course of time the advocacy was rewarded by the disposal of the whole of his coke within the area of the speaker's gas undertaking.

These examples may be supplemented by others where similar tactics have been adopted. One Lancashire town can be cited where the broken-coke sales amount to 23 per cent. of the whole quantity sold; the figures for last year being 3232 tons out of the total 13,817 tons. In another case the percentage of broken coke had risen to the gratifying figure of 33, which could leave little or no coke for sending outside the home district.

Votes of Shareholders as Councillors.—After a discussion in the Guildford Town Council with regard to the lighting of certain streets in the borough, Alderman Patrick, J.P., asked if shareholders in lighting companies had any right to vote. Mr. Shawcross said he had noticed that two or three shareholders in lighting companies had voted. The Town Clerk remarked that the section of the Act stated that no member should vote on any matter in which he was directly or indirectly interested. Mr. Froome suggested that the voting on the question of whether or not the Committee's report should be adopted should be taken again. The Mayor, however, said he did not know who were shareholders of companies. He could not stop them; and he should not take the vote again.

VERTICAL RETORTS FOR LEIGH.

At a meeting of the Leigh Corporation last week, the minutes of the Gas Committee were passed authorizing the borrowing of £11,420 for gas-works purposes.

Alderman Fairclough said the matter had been under consideration for the last six months. If they were to maintain an efficient supply of gas, they were bound to adopt some fresh system. The old retorts were practically worn out; and it would be as much as they could do to supply the amount of gas which would be required during the winter months without using the carburetted water-gas plant. The Special Sub-Committee had visited various towns; and, after studying three systems of carbonization, the Gas Engineer had shown them conclusively that to produce the same amount of gas under the inclined system cost £4947, the Glover-West continuous system, £3721, and the Dessau system, £3366. The Gas Committee recommended the Council to approve of the Dessau system. The Dessau contractors guaranteed 14,500 cubic feet per ton; but the Committee, to be on the safe side, estimated for 14,000 feet.

Mr. Gregory said a regrettable feature about the suggested alterations was that the new system would mean a reduction in the staff. Many of the men had worked for the Corporation for a number of years. Mr. Hunter remarked that whenever there was a possibility of cheaper gas, there was a demand for newer plant. Some years ago they levied a special rate of 1s. 6d. to put the undertaking in a better condition. Mr. Grundy pointed out that over £40,000 had already been given to the relief of the rates. Their present estimated production from inclined retorts was 630,000 cubic feet per diem, and for the horizontal retorts 60,000 feet. The maximum consumption on Dec. 23 was 845,000 cubic feet, so that the difference had to be made up with water gas. If any of the plant broke down, there was no margin. The Gas Engineer had reported that he would not be responsible for the full supply of gas next winter unless additional carbonizing plant was installed. Being aware of this fact, the Committee had visited certain towns in order to decide upon the best and most economical system.

Alderman Fairclough said that work would probably be found in other departments of the Corporation for the men displaced; and after this statement, the minutes were passed.

WORKMAN SUFFOCATED BY AMMONIA FUMES.

An inquiry was recently held at Greenwich, by Mr. H. R. Oswald, in regard to the circumstances attending the death of William George Piper, aged 20, a labourer employed at the East Greenwich station of the South Metropolitan Gas Company, which took place at the Seamen's Hospital as the result of inhaling the fumes of ammonia while in the sulphate stores on the 20th ult. Mr. Washington represented the Company; and there were present Mr. F. J. Bywater, the Engineer of the station, and Mr. H. T. Ringrove, Inspector of Factories.

The father of the deceased stated that his son was first treated at East Greenwich Infirmary, but was discharged on Dec. 23. He subsequently entered the Seamen's Hospital, where he died on Tuesday last week. A brother said that when he saw deceased at the infirmary on the 22nd ult. he said he thought he was leaving the infirmary next day. He did not seem as if he wanted to stay there. After leaving the infirmary he went to witness's house in Grenfell Street, where he got worse, and was removed to the Seamen's Hospital. Deceased was found unconscious on the conveyor stage in the sulphate stores, 30 feet from the ground. There was a very strong odour of ammonia, but witness was not affected, and he said he had never heard of any workmen being overcome by them. There was a notice warning them to keep out of the way until the danger of the fumes had been removed. Apparatus was provided for treating men who were overcome. James M'Duff, an employee, said Piper was very inquisitive, and was repeatedly told of the danger of coming in contact with the fumes. There was no ventilation where deceased was found, as it was necessary that the plant should be kept dry. It was the first fatal accident of this character at the station in the sixteen or seventeen years witness had been employed there. Dr. Davies said that he was called to Piper at the works, and found artificial respiration was being performed. The man was in a dying condition, and witness immediately administered strychnine, and also oxygen. But for these prompt measures, he might have succumbed then. He gradually recovered, and was removed to the infirmary. On Boxing Day, witness was summoned to the house in Grenfell Street, where he found him in a semi-comatose state. He was then admitted to the Seamen's Hospital. If he had remained at the infirmary he would have had a very good chance of recovery. Dr. Williams, the House Physician at the Seamen's Hospital, deposed that the autopsy revealed fatty degeneration of the heart, liver, and kidneys—a condition brought about by ammonia gas poisoning—and pneumonia. Death was due to the complications consequent upon the gas poisoning. Four doctors were present at the examination, and all agreed that had Piper remained at the infirmary he would have recovered.

The Coroner, in summing up, commended the prompt measures taken by Dr. Davies and the Company's employees to restore animation. The Jury returned a verdict of "Accidental Death," and recommended that the place where deceased was found should be ventilated.

Mr. George R. Hislop, Gas Engineer and Manager of the Paisley Corporation, is recovering from the injuries sustained by him in a street accident some time ago. His non-attendance at a Gas Committee meeting, owing to his illness, has brought to light the interesting fact that this was his first absence from such a meeting during 48½ years' service as Gas Manager.

USE OF GAS-HEATED RADIATORS IN FACTORIES AND SCHOOLS.

Interviews with Officials of the Home Office and Board of Education.

We reproduce below from the British Commercial Gas Association "Bulletin" for January some notes by Mr. F. W. Goodenough, as to his interview on the above-named subject with the Chief Inspector of Factories (Mr. Gerald Bellhouse).

As is only too well known, for some time past gas undertakings have had considerable trouble with the factory inspectors over the question of flueless gas-stoves and radiators fixed in factories and workshops; the Home Office Inspectors taking up the attitude of condemning flueless stoves without regard to the conditions under which they are used. The Factory Act, while compelling the occupiers of factories and workshops to heat their premises adequately, provides that no means of heating shall be used which interferes with the purity of the air.

Mr. Goodenough reported as follows to the Committee of the Association :—

"I found that Mr. Bellhouse and the Home Office generally were inclined to the view that a flueless stove necessarily interfered with the purity of the atmosphere, because it discharged products of combustion into the room, and that, on that ground, they were justified in condemning flueless stoves, as such, under any conditions.

"I pointed out to him that in many cases, owing to the circulation of air set up by the heated products from the stoves, the condition of the air at breathing level was actually better when flueless stoves were in use than when they were not alight; and that there was no legal ground for condemning flueless stoves in any case unless they were proved, and not merely assumed, to interfere with the purity of the air breathed by the occupiers of the factory or workshop.

"Mr. Bellhouse evidently felt that there was force in the argument, and promised to put our point of view before Sir Arthur Whitelegge, the Chief Inspector of Factories for the United Kingdom, and to see that it received full consideration. He also promised that, if necessary, we should be given further opportunity for discussing the question, which is of great importance to the gas industry throughout the country.

"Mr. Bellhouse was at first inclined to the view that no settlement of the question was possible until a case had been fought out in the Courts of Law to determine what was the true interpretation of the Factory Acts. But I think I persuaded him that it was quite possible for an interpretation of the Acts to be agreed upon between the Home Office and the gas industry which would be regarded as fair and reasonable by the latter, while properly safeguarding the health of the workpeople.

"On the same day I had an interview on very much the same subject with the Architect and Medical Adviser to the Board of Education; the only difference being that the point under consideration was the use of gas for heating in schools instead of in factories.

"Here, again, I met with a quite sympathetic reception, and feel, as a result of the interview, that the Board will be inclined to give much fuller consideration to gas heating on its merits when proposals are put before them by the managers of schools for the installation of gas in their buildings than formerly.

"I should add that, in regard to both the Home Office and the Board of Education, the papers read at the recent conferences at the National Gas Exhibition had, I found, aroused considerable interest in the minds of the officers concerned with the questions of heating and lighting factories and schools, and had undoubtedly made a favourable impression."

GAS v. ELECTRICITY IN CARLISLE.

Competition between Committees.

The Gas Committee of the Carlisle Corporation annually provide out of their profits large amounts which are devoted to the reduction of the rates, and the gas undertaking stands as one of the city's biggest assets. Since the development of the electricity undertaking there have at times been complaints by the Gas Committee against the Electricity Committee for offering terms which have deprived them of some large consumers. At last week's meeting of the Town Council, a minute was submitted by the Gas Committee to the effect that the Council should be recommended to order that whenever the Gas or the Electricity Committee are requested to quote prices for lighting or power, the Engineers, and, if necessary, the Committees, shall confer before any quotation is made, with a view to preventing unnecessary competition and cutting of prices.

Mr. GIBBINGS, the Chairman of the Electricity Committee, objected to the minute, and moved its deletion. He repudiated any insinuation that the Electricity Committee had acted secretly with their prices, or had in any way poached on the gas preserves; and the minute, so far from allaying friction, would, he said, be a fertile breeder of it. He went on to criticize gas, and remarked that, unlike electricity, its profits largely depended upon the price of residuals, which fluctuated greatly. He thought, with increasing science, residuals would drop more, and some day the Gas Committee would have a rude awakening, and eventually find gas displaced by electricity. In his opinion, the Council would be well advised if, instead of putting obstacles in the way by adopting the resolution of the Gas Committee, they realized the situation. He denied cutting prices, and said the resolution was an attempt to fetter the freedom of action of the Electricity Committee.

The MAYOR (Major Ferguson) explained that the object of the resolution was to prevent any big consumer approaching both Committees with the view of playing off one quotation against the other and squeezing lower terms. There had undoubtedly been competition between the Committees; and it was a suicidal policy.

Mr. J. P. BUCK, the Chairman of the Gas Committee, said, so far from the gloomy predictions of the Chairman of the Electricity Committee, that gas was to become obsolete and the Gas Committee doomed, he might tell the Council that gas would be manufactured when electricity was "on the scrap heap." It was interesting to note that in one of the important divisions of London the electric standards were being taken down, and the latest high-pressure gas-lamps substituted for them. This was something to show that gas was not exactly obsolete, or likely to be.

On a vote being taken, the Gas Committee's minute was adopted.

THE SMOKE PROBLEM AND ITS SOLUTION.

"The Smoke Problem" was the title of an article in the "East End Observer" for the 10th inst., in which the residents in the large and populous district of London specially referred to had brought before them the important subject of the production and prevention of smoke.

The writer began by stating that smoke is coal gas in its crudest form, mixed with soot, tar, sulphur, and in some cases ammonia. He next proceeded to explain how smoke is converted into fog, and showed that, while mist cannot be prevented, the production of smoke can certainly be checked. The effects of smoke on the atmosphere, the sunlight, clothing, and household draperies are not, in the writer's opinion, sufficiently realized; otherwise people would not be so oblivious to its destructive nature. He quoted Professor Cohen, Sir Thos. Barlow, and the Hon. Rollo Russell to show the quantity of soot thrown into the air by the consumption of coal, the effect of this in obscuring sunlight, and the great loss of money entailed by the extra washing and wear and tear of linen, &c., owing to the dirt, apart from increased mortality.

Having considered the composition and formation of smoke, mist, and fog, and the evils resulting therefrom, the writer considered what could and should be done by individual manufacturers and householders to abate this pernicious nuisance. Taking factories first, he showed that the consumption of coal in them exceeds 100 million tons per annum, compared with 32 million tons burnt in domestic grates. Factories, however, produce as smoke only from 0·5 to 0·75 of the coal used, while domestic grates do it to the extent of upwards of 5 per cent. According to Dr. D. N. Shaw, 70 per cent. of the smoke in London is domestic. What can be done to prevent this contamination of the atmosphere? This is the question the author proceeds to answer. As the bulk of the smoke is produced from kitchen grates, the best remedy is to abolish this part of the domestic household, and use gas-cookers. This disposes of cooking and the boiling of kettles. But then comes the question of how a supply of hot water is to be obtained. The writer disposes of this by advising the hire of a gas-heated hot-water circulator, and having it connected to the hot-water pipes. In smaller houses, which are not fitted with these, he says there is nothing to beat a geyser in the bath-room. The kitchen grate, however, is not the only offender. The grates in the sitting and bed rooms add their quota to London smoke and fog. The remedy is, of course, the substitution of gas-fires.

The conclusion arrived at by the writer is that the householder can, if he wishes, practically solve the smoke problem; and he urges him to extend the use of gas in the several ways pointed out, and thereby "hasten the day when the murky fog will be a thing of the past."

COAL GAS FOR DOMESTIC AND INDUSTRIAL PURPOSES.

Lecture by Mr. Halkett.

An interesting lecture on the above-named subject was delivered by Mr. Ralph Halkett, the Superintendent of the Distribution and Sales Department of the Glasgow Corporation, in the Lesser Town Hall, Govan, last Thursday evening. The points of the lecture were illustrated by cinematograph films; and model appliances were used to enable the audience to understand the different processes referred to. In the course of his lecture Mr. Halkett spoke as follows:

In years gone by gas would have failed to be of such signal service to the public as it now can be. The Corporation took over the gas supply of Glasgow in 1869, and the price then charged was 4s. 7d. per 1000 cubic feet. In 1875 it had risen to 5s. 5d.; but in 1885 it had dropped to 3s. 6d., and has continued to decrease steadily until now it is 1s. 11d. The price at present compares very favourably with that of coal; and during the recent strike among the miners, while the price of coal went up by leaps and bounds, that of gas remained constant, and consequently the consumption increased very considerably.

The Corporation give light for the streets, the shops, the factories, and the homes. This was economical, efficient, ornamental, and hygienic. They could heat dwellings, offices, factories, shops, churches, and other public institutions in a perfectly satisfactory way, and at a small cost and little labour. They could give power, by which to drive engines and machinery in workshops, which would prove more efficient than anything that coal has been able to do, and far cheaper.

Light, heat, and power were the three great factors in home and business. They needed plenty of light, but of a kind that would not prove harmful. For a considerable time, electricity held first place as a lighting agent on account of its cleanliness, its illuminating power, and—chief of all reasons—the ease with which the light could be obtained, together with its non-heating properties. The adherents of gas had caused them to study the question of lighting more seriously than before, and justify its use as an illuminant. With the invention of the incandescent mantle, gas lighting rose by leaps and bounds. The upright mantle was eventually superseded by the inverted mantle, and scientists and medical men agreed that, under present conditions, gas is the best and most hygienic illuminant of modern times.

As a means of ventilation, the merits of gas were neither well known nor fully appreciated. The slight discoloration of the ceilings above gas-burners was a proof of the part it takes in purifying the air,

though this, together with the slight heating of the air which ensues, has been marked down to its discredit. It was becoming better known now, and since the interest in all pertaining to gas had become more widespread, that the discoloration did not come from the gas itself as was once commonly believed. It was the outcome of the action of the combustion of gas upon the impurities in the air. This was, therefore, a beneficial action, since it charred and deposited these impurities where they could do no harm, by means of the heated currents of air that arose from its use. This heating of the atmosphere caused gas to be claimed as one of the best means of ventilation in artificially lighted or heated apartments.

That medical authorities have proved for themselves which was the most satisfactory method of lighting was instanced by the fact that in the Medical Institute in London, which was first lighted by gas, this was all taken away and electric lighting installed, only to be shortly afterwards replaced by gas in the most modern form, because of its reliability, efficiency, and hygienic qualities. Tests taken of the air in rooms lighted and heated by gas had shown it to be much fresher and purer than in rooms lighted by any other method. There was no smell given off by the gas-burner when used in any capacity ; and the light was steady and constant, unless the burner had become dirty. In utility and beauty, gas-fittings vied with the best ; and it was a perfectly simple matter to find some which were suitable for any room and any position required.

Sometimes it was argued that mantles were a source of expense ; but this should not be the case. In his own kitchen, where lighting was not always carefully or correctly done, a mantle had been in constant use for ten months. With careful lighting, mantles should last much longer than this. It was advisable always to buy a good class of fitting, and a good make of mantle. The initial outlay was always recouped in the long run by the greater wear and tear it would stand. The cheaper makes of mantles rarely stood usage for any length of time, and had to be replaced much more frequently ; nor did they give the same candle power.

For street and shop lighting, and for large factories and public institutions, high-pressure gas lighting met all requirements, and was coming very much to the front. By means of it a higher efficiency was obtained, with a saving in gas consumption. In Glasgow they had the public lamps in Bath Street fitted with high-pressure lighting, and doubtless the audience would have noticed the great difference between it and other methods of lighting. It was a splendid way of illuminating the outside of shop windows and business premises while economizing in gas consumption ; and the keen business man would not be slow to grasp this fact, if once he was induced to study the question. For a city like Glasgow, he had been astonished at the very small amount of outside shop lighting that existed. No better attraction could be found than a brilliantly lighted shop front. In London and other large cities the fact was fully recognized ; and high-pressure lighting consequently was largely adopted.

It was not in lighting alone, however, that gas had forged its way to the front. Its claims as an agent of heat and power for domestic and industrial purposes were as urgent and as fully justified as for lighting. It was in June, 1912, the Glasgow Gas Department decided to let out gas-fires on hire, and since that time there had been about 20,000 fixed —a proof that they are not only very useful, but that they give entire satisfaction.

Mr. Halkett said he should not be doing justice to the gas industry nor to the smoke abatement movement if he failed to point out that gas had gone yet farther afield in its endeavours to prove itself an adequate substitute for coal as a fuel, and that a great field of utility lay before it in the industrial world. Though the domestic chimney was undoubtedly, because of its numbers, the chief offender in polluting the air, yet the great volume of smoke belching forth from the chimneys of our great manufacturing places was almost equally criminal, and was even more offensive to the eye. In many cases gas-furnaces had superseded the older form of fuel-furnace, particularly for such trades as annealing, case-hardening, tempering, metal-melting, and for forges, &c. Many large electrical firms relied upon the assistance of gas in manufacturing their various electrical commodities ; and in glassware factories it had proved invaluable—being, in fact, the means of firms recovering work that had been taken from them to be done abroad. There was scarcely a trade in which gas could not be utilized with advantage.

On every hand gas-engines and all other gas appliances were being found by the manufactures to be more efficient and labour saving, as well as more economical, than others ; and, in spite of all that the gas profession had yet done, there was still ample scope for a great deal more. Their efforts had met with much success in both the domestic and the industrial world ; but they looked to the future to bring even greater successs. So that it was possible, with the public's valuable co-operation, they might look forward to breathing city air unpolluted with smoke, seeing blue skies, and enjoying as much sunshine as they found when they went to the country and seaside in search of these great essentials of health.

Derwent Valley Water Scheme.—Latest engineering reports indicate further substantial progress in regard to the other sections of the work as to which statutory obligations devolve upon the Derwent Valley Water Board. Since the last official particulars were published, additions have been made to the massive Howden dam, making the total quantity of masonry built into the main dam 285,997 cubic yards. A length of 4050 yards of embankment has been completed. Some idea of the massiveness of the neighbouring dam, the Derwent, is also afforded by the statement that the total quantity of concrete masonry and stone facing therein involved is 362,353 cubic feet, including the wasonry in the towers, pylon, parapet walls, apron, and retaining mall. Some interesting work is also being effected on vacant ground es to afforestation. The net total expenditure so far is represented by £3,445,763.

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NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Mr. D. Fulton, the Secretary of the Scottish Junior Gas Association, Western District, has sent out his usual carefully compiled billet, regarding the visit to the Glasgow Corporation Stove and Meter Workshops on Saturday next. The Corporation workshops are complete and up to date in all matters connected with the up keep and repair of stoves and meters; and a large staff is employed there. This opportunity of seeing meters in various stages of repair and under test is one which should be taken good advantage of.

The Town Council of Kirkintilloch have been receiving a deputation from the Glasgow and West of Scotland Master Plumbers' Association on the same subject as has formed the basis of a correspondence with the Edinburgh and Leith Gas Commissioners. The plumbers are again objecting to the inclusion of the supplying and fitting of gas cookers, stoves, fires, radiators, and other heating and lighting appliances in the business of a gas department. If the plumbers can show that they have in the past done their share in the advertising, pushing, and giving instruction in the use of these appliances, they would have a strong point in their favour. But can they do this? Can they show that they or their employees really understand the use of gas for these purposes? Modern gas-stoves and gas-lights require very different treatment and knowledge of their design from those formerly used, and the examples of ignorance which one finds in many parts show how necessary it is that properly-trained men only should be employed in the fitting and adjustment of such apparatus. The Gas Committee have been asked to bring up a report on this matter at the next Council meeting.

The Coatbridge Gas Company and their Manager, Mr. Thos. Wilson, have received a high compliment at the hands of the Town Council of that burgh. A suggestion was made at the Council meeting that they should proceed to consider, and carry into effect, the purchase of the undertaking and works of the Gas Company, as it was considered in the interests of the public. An amendment, however, was moved that the time for purchase was inopportune, and that Coatbridge gas was the cheapest in Scotland. The motion was defeated by 11 votes to 3. It was a bold move to bring forward a proposition to purchase an undertaking which is supplying gas at the low price charged in Coatbridge, as it is impossible to see how a Town Council, after paying the sum necessary for the concern, could possibly further reduce this low figure. The fact that the motion was defeated by such a large majority shows how excellently the Directors of the Company have done their work.

The Musselburgh Gas-Works, which are situated at one end of the well-known golf links and racecourse, are to obtain the piece of ground which they desire to feu from the town for the necessary extensions of their works. The Provost and Law Committee have been discussing the question with the Gas Company for some time past, and have at last come to terms under which the ground will be put up to public auction. The portion of land is to be restricted to the production and storage of gas only. A road is to be made in a new position, and the old one lifted, at the expense of the Gas Company. The agreement to feu was adopted by the Council without a division.

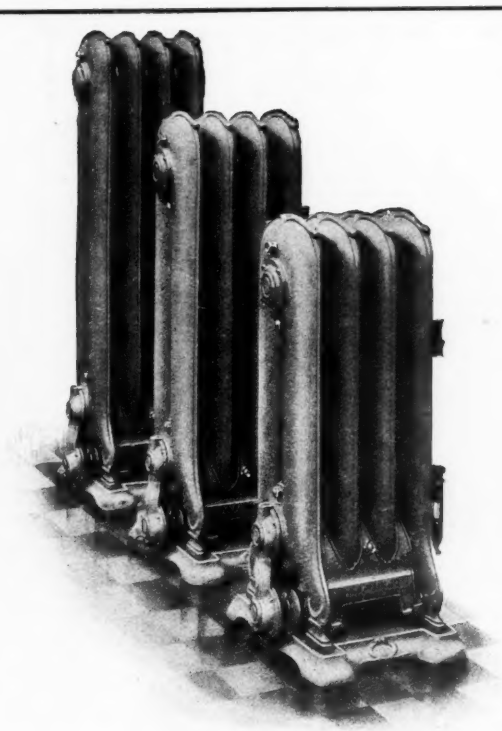
At Greenock the recommendation of the Gas Committee to apply to the Secretary for Scotland for permission to borrow £50,000 was carried by 15 votes to 4. This money is required for an extension of the existing carbonizing plant on the vertical system, and for the erection of a new gasholder and tank at Inchgreen Gas-Works. Mr. J. M'Leod, the Gas Manager, has reported that the present condition of the carbonizing plant is unsafe, and that an immediate extension is absolutely necessary.

Mr. Ralph Halkett, the Commercial Superintendent of the Glasgow Gas Department, delivered during the week a lecture on coal gas for domestic and industrial purposes, a report of which will be found in another part of the "JOURNAL."

The Dufftown Town Council resolved to adopt the report of the Lighting Committee, to give them full powers to consult experts with regard to the introduction of coal-gas lighting into the burgh, and to decide on a suitable site for the erection of the gas-works.

The Gas Committee of the Dunfermline Town Council have been asked to quote terms for a supply of gas to Aberdour, which is about 8 miles distant. The great distance, however, would cause such a capital expenditure that the Dunfermline people are not prepared to consider the question at the moment, as they fear that any price they might quote would not be to the mutual advantage of the two places. It was suggested that it would be a better plan for Aberdour to get a supply from Burntisland, which is only about 3 miles away. No doubt the desire on the part of the Aberdour folks for the Dunfermline gas is due to the fact that it is being sold at the rate of 2s. 3d. per 1000 cubic feet, less discount; while the Burntisland price is 3s. 4d. It is a wonder that Burntisland has not supplied Aberdour long since, and no doubt, had the works been built on the site to the west of the burgh, as was suggested a few years back, it would have been an extra inducement for the carrying of a high-pressure main to supply Aberdour. At present certain premises are being lighted by acetylene and others by petrol gas. Dunfermline has also been discussing the question of wages at the gas-works; and despite the protest of the Treasurer, who was anxious to delay any increase until the financial year was ended, the Council decided to grant the rise in wages to the stokers, hoist men, and sulphate workers. It was stated that the Gas Committee found it necessary to follow other corporations in granting increases, or discontent was caused at the works. The Committee wanted good work, and they could only get this by paying good wages.

The Banchory Town Council have been waging a wordy warfare with the Gas Company over the Council's repeated application for the discount to large consumers. The Company's Directors said that, as there was no circular of discount sent to the Town Council, they intend



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to adhere to their former decision, and suggested that the Council were trying to teach them how to conduct their business. The Council decided to stand to their former position, and insist upon receiving the discount.

It is not often that one finds correspondence in the public Press dealing with the effects of glare upon the eyesight; but such letters have been appearing during the last few days in the "Glasgow Herald," and reference has been made to the experiments carried out by Dr. Meredith Young, the Medical Officer of Health and Chief School Medical Officer to the Cheshire County Council, and mentioned in his lecture on "Light and Sight," by which he showed that, while with a 50-candle power osram lamp at 27 inches distance he obtained temporary blurring and did not regain his normal vision for from 100 seconds to 110 seconds, with an incandescent gas-lamp, under similar conditions, the normal vision was regained in 80 seconds, and no blurring whatever occurred.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

There was a considerable amount of business done in tar products last week, and the value of the chief items has been maintained.

Pitch remains at 41s. net, and this value is confirmed by business done in the country at the same price. Ordinary creosote is at least 3⅜d. free delivered Thames, and for export something over this can be obtained. There is no change in benzol, except that it is somewhat firmer, and the demand is so good that supplies are running short. A considerable quantity of crude carbolic has changed hands at about 1s. 1½d. usual terms for 60's, but the outlook has not improved. The best makes of anthracene remain at 2d. per unit net for 45-50 per cent. quality. Pyridine is from 8s. to 8s. 1½d., and inquiries are made for deliveries into 1915.

Sulphate of ammonia has unfortunately receded further, and 25 per cent. guaranteed cannot be called higher than £11 17s. 6d. net and naked at works. At the same time the feeling is better, and the cessation of the troubles on the Continent is bound to have a reassuring effect. It is very correctly pointed out in Messrs. Bradbury and Hirsch's valuable report, that if prices were to fall much further, nitrate of soda could hardly continue in the field, and it has to be remembered that sulphate is a most vigorous competitor and much more to be feared now than formerly, as so much more is made, and consumers who have once taken to sulphate rarely give it up. A great deal of sulphate has been sold this week.

Tar and Tar Products in the Provinces.

The average values during the week were: Tar, 27s. to 31s. Pitch, east coast, 38s. 6d. to 39s. 6d.; west coast, Manchester, 38s. 6d. to 39s. 6d.; Liverpool, 39s. to 40s.; Clyde, 38s. 6d. to 39s. 6d. Benzol, 90 per cent., naked, North, 11½d. to 1s.; 50-90 per cent., naked, North, 11d. Toluol, naked, North, 10⅝d. to 11d. Crude naphtha, in bulk, North, 5d. to 5¼d. Solvent naphtha, naked, North, 9¼d. to 9⅜d. f.o.b. Heavy naphtha, naked, North, 9d. to 9⅛d. f.o.b. Creosote, in bulk, North, 3d. to 3⅛d. Heavy oils, in bulk, 3⅜d. to 4d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 1s. 0½d. to 1s. 1d. Naphthalene, £4 10s. to £10; salts, 55s. to 60s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d. per unit; "B" quality, nominally ⅝d. per unit, packages included and delivered.

Sulphate of Ammonia Prices in the Provinces.

LIVERPOOL, *Jan.* 17.

Throughout the past week the market for this material has continued to have a drooping tendency, although prices have not given way quite so much as they did during the previous week. New export orders have not been too plentiful, but within the last day or two there has been rather better demand for covering January sales. The nearest values at the close are £12 5s. per ton f.o.b. Hull, £12 6s. 3d. per ton f.o.b. Liverpool, and £12 8s. 9d. per ton f.o.b. Leith. The rapid decline in the near position has caused buyers to hesitate about operating for forward delivery, and no first-hand transactions have been reported.

Nitrate of Soda.

The value of this article has receded to a small extent, and the quotations on spot are now 10s. 4½d. per cwt. for ordinary and 10s. 7½d. for refined quality.

From another source it is reported that there has been a considerable fall in the price of sulphate during the past week, and buyers have certainly had the best of the deals. Outside London, makes have been offered at £11 10s. to £11 12s. 6d. In Hull, business was done at £12 7s. 6d. and could not be repeated. At Leith, the quotation is £12 10s.; Liverpool, £12 7s. 6d.; Middlesbrough, £12 7s. 6d.

Automatic Lamp Lighting at Wakefield.—The Wakefield Lighting Committee have decided to adopt the Broadberry pressure system for lighting and extinguishing the public gas-lamps. No permanent employees of the Lighting Department will, however, be thrown out of a job, as other suitable employment is to be found for them. It is pointed out that the system will allow of all the lamps being lighted simultaneously, that it can be put in operation immediately in case of a fog suddenly enveloping the city, and that the Gas Company will only charge for the time the lamps are actually burning. All the lamps will not be converted at once; and so the reduction of labour will be a gradual process. Among the advantages claimed for the scheme is some saving in the consumption of gas; but what is regarded as the chief benefit is the reduction of the night work of the lamplighters.

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COAL TRADE REPORTS.

Northern Coal Trade.

The coal trade is active, and there is now a good demand for this season, so that the shipments are about an average. In steam coals the inquiry is good for a time in which some of the large users abroad have the ports closed with ice. For best Northumbrian steams, about 14s. per ton f.o.b. is now the quotation. Second-class steams are from 12s. to 12s. 6d. per ton f.o.b.; and for steam smalls, the prices vary from 6s. to 7s. 3d. per ton, according to the quality—supply being generally full. In gas coal there is a steady demand, which is fully met by the large output. For best Durham gas coals, 14s. 3d. per ton f.o.b. is now the current price for early delivery; while second-class gas coals vary from about 12s. 6d. upwards. "Wear specials" show no alteration in current quotations. As to contracts, Durham coals have been sold for Paris gas-works at about 17s. per ton delivered; and allowing for freight, &c., this may leave about 12s. 6d. per ton f.o.b. for best Durhams. The Copenhagen contracts have been allotted at prices from 16s. to 18s. per ton delivered, according to the class of coal. These figures are naturally below those of a year ago; the fall being from 2s. 3d. per ton—a decrease due in part to the lower freights expected, as well as to slightly cheaper coal. This lower price will influence other contracts. Coke is steady. Gas coke is now plentiful and rather lower; good makes being 13s. 6d. per ton f.o.b. in the Tyne.

Lambeth Council and the Gaslight and Coke Company's Bill.

The Lambeth Borough Council, at a meeting on Friday, considered a report from the Town Clerk on the Gaslight and Coke Company's Bill, which has been deposited for next session. He said it would appear that the Company's proposals, if consented to by Parliament, would entirely wipe away any standard illuminating power for gas supplied by them. The General Purposes Committee reported that since the introduction of incandescent mantles various precedents had been established by Parliament for the reduction of the illuminating power of gas from 16 to 14 candles, but they were uncertain whether any had been created for the powers now proposed by the Company. As, in the opinion of the Committee, it was desirable that the Town Clerk should confer with the promoters of the Bill, the London County Council, and the other authorities concerned, they had instructed him to do so, and, if considered necessary, to consult his Parliamentary Agents upon the powers sought by the promoters. A report would be presented to the Council in due course as to whether or not it was necessary to petition against the Bill. The report was adopted.

Public Electric Lighting at Hastings.

The Hastings Town Council, at their meeting last Friday, had before them a report from the Borough Electrical Engineer, stating that within the area of All Saints Street and High Street there were 58 gas-lamps which could be fitted for lighting by electricity, at an estimated cost of £540 4s.; that the interest and sinking fund on the capital expenditure would be about £33 15s. per annum, and the profit on the 58 lamps, taken at 30s. each, would be £87 10s. per annum, without taking into consideration the possibility of new consumers when the mains were laid. The Public Lighting Committee recommended that the extensions be carried out. The Finance Committee pointed out that the actual fitting of the lamps for lighting by electricity would involve a capital expenditure of £174, which amount it was proposed to include in the Committee's estimate for the ensuing financial year. Mr. Mannington and Alderman Chesterfield criticized the report. The former pointed out that it was the first time they had had an application for a loan purely for the purpose of converting gas-lamps. The proposal would impose a burden on the rates to the extent of £174; and the electricity concern was being subsidized out of the rates. Alderman Chesterfield said he wanted to help the concern in legitimate business, but failed to see how the present proposal could in any way be a source of profit. The recommendation was, however, adopted.

Use of Gas for Testing Petrol Engines.—In consequence of the increasing cost of petrol, an example which has been set by a number of motor-car manufacturers in the Coventry district, and also by several in the United States, is now being followed by the Argyll Company, of Alexandria, N.B., who have lately substituted gas for petrol in the engine-testing shop. The gas is taken from the town mains.

Reduction in Price at East Cowes.—The Directors of the East Cowes Gas Company announce a reduction of 3d. per 1000 cubic feet in the price of gas to ordinary consumers, and a proportionate reduction to prepayment meter users, as from March 31 next. In order to cope with their rapidly increasing business, the Company have erected handsome new show-rooms and stores adjoining the offices. During the last four years there has been an average increase in the consumption of gas of a million cubic feet a year; and for the highly efficient state of the gas-works, the growth of the concern, and the granting of numerous public concessions, great credit is accorded in the local Press to the able and experienced Manager, Mr. Robert Fish.

Motor Haulage by Gas Companies.—With the view of promptly dealing with the orders received from the consumers in their very extensive area, the Aldershot Gas, Water, and District Lighting Company have introduced a number of motor lorries, each capable of conveying a load of 3 tons. By their aid, it will now be possible for connections to be made with new residences, or for gas-stoves and other appliances to be packed and at their destination in much less time than would have been required under the old system of delivery. This innovation is evidence of the determination of the Company's General Manager (Mr. R. W. Edwards) to keep the undertaking with which he is connected thoroughly abreast of the times.

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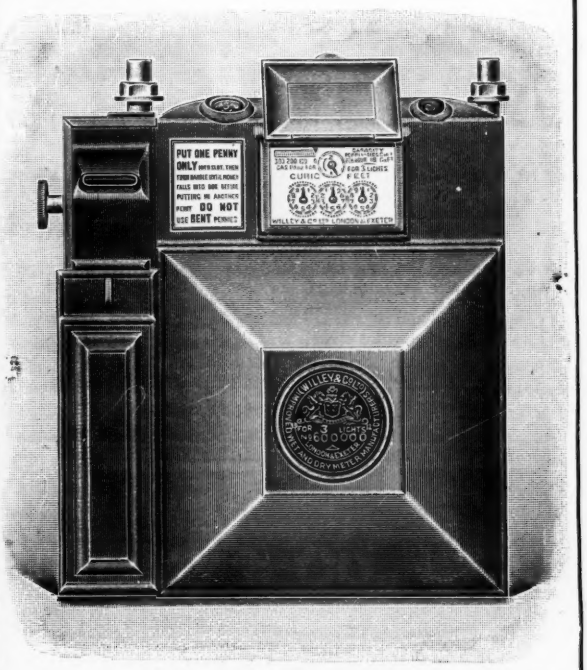

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Gas Testing at Mossley.—A deputation of the Mossley Corporation authorities appeared before the Board of Trade last week in support of an application for permission to adopt a more up-to-date appliance for testing the candle power of the gas. The deputation comprised Councillor Mills (the Deputy-Chairman of the Gas Committee), Councillor Gartside, and the Town Clerk (Mr. J. Hyde). The Saddleworth District Council had entered opposition, on the ground that if the application was granted the statutory illuminating power to which the district was entitled would be reduced, and they asked for concessions—the principal point urged being that the differential rate of 2d. per 1000 cubic feet paid by Saddleworth should be discontinued. Both sides instructed Counsel; and the proceedings lasted about five hours. The result of the application will be made known in due course.

Bolton Corporation Bill Dropped.—At a meeting of ratepayers of Bolton on the 7th inst., objection was taken to clause 42 of the Bill of which the Corporation have given notice, on the ground that power to close all footpaths on the moorland watershed, as proposed, ought not to be placed in the hands of the Water Committee. Following upon this the Committee decided to withdraw all their clauses from the Bill; and the Parliamentary Sub-Committee recommended the General Purposes Committee to proceed with the Bill *minus* these clauses. The last-named Committee's recommendation to the Council, however, was to drop the Bill entirely. The subject was discussed by the Town Council for nearly three hours on Monday last week. Mr. Rimmer, the Chairman of the Water Committee, said that without clause 42 the Bill would be useless; and the General Purposes Committee's recommendation was eventually approved.

Reduction in Price at Abertillery.—On the recommendation of the Gas Committee, the Abertillery Urban District Council have reduced the price of gas to ordinary consumers 4d., and to slot consumers 5d., per 1000 cubic feet; the rates now being for the former consumers 3s. to 2s 6d., according to quantity, and for the latter 3s. 7d. Since Mr. L. J. Langford's appointment as Manager five years ago, the reductions made to ordinary and slot consumers amount respectively to 6d. and 7d. per 1000 cubic feet.

Coal and its Bye-Products.—Last Monday evening an interesting lecture on this subject was delivered at Maesteg, by Mr. D. C. Davies (county mining lecturer). He said that formerly coke was produced by burning coal in a heap covered with coal dust or earth; and all the gases from the coal were thus burnt or lost in the air. The coke obtained was excellent; but the production was very wasteful. Now by modern processes there were obtained out of every ton of coal treated 12 to 15 cwt. of coke, worth £1 10s. per ton; 30 lbs. of ammonia, worth £12 10s. per ton; 100 lbs. of tar, worth £1 14s. per ton; 2½ gallons of benzol, worth 2s. 6d.; and 5000 cubic feet of gas.

The Bradford Corporation Gas Committee are to consider the question of the supply of gas stoves free of charge, and of providing gas for the stoves at a cheaper rate.

We have received from the K. & A. Water-Gas Company, Limited, of No. 56, Victoria Street. S.W., a copy of their new illustrated catalogue. The Company's system is fully described, and particulars are given of important installations of their plant. The pamphlet has been very well got up.

GAS COMPANIES IN THE STOCK EXCHANGE.

The Stock Exchange has had a really remarkable week. The proverbial turn in the long lane of depression came at last, and with almost bewildering suddenness. Signs were not altogether lacking in the early portion of the week of a genuine desire to invest being created by the increasing ease of money; but the incubus of the South African trouble rested heavily upon the markets. As soon, however, as the bogey was effectually laid (and concurrently the Money Market eased off still more), there was no stopping the upward march, and prices—especially of the choicest securities—rose by leaps and bounds. Business on the opening day was very sluggish, taken all round; preparation for the settlement being in hand. The tone, however, was fair in most quarters. The gilt-edged division were firm, and Transatlantics found support, but Rails underwent realizations. The tendency on Tuesday was less bright generally except for high-class articles. Rails were dull with lower figures, the Foreign Market was weak, and Transatlantics were irregular. Wednesday was depressed by the threatening aspect of affairs in South Africa. Government issues were not strong, and Foreign continued dull. Railway ordinaries were rather weaker; but the secured issues were in demand. Movements were irregular on Thursday, and some quarters were hit by special weakening factors—such as Mexicans. Consols fell ⅛, and Rails dropped for lack of buyers, but Transatlantics were rather stronger. Such was the position when on Friday came the remarkable rebound mentioned above. Under the genial influence of cheap money and the victory of law and order in South Africa, the markets in general had a very bright day—a phenomenon not as a rule associated with Fridays. Consols rose ¾; and almost everything else was buoyant, even the depressed Foreign Market getting up a smile. Saturday was just as cheerful, and rising prices ruled everywhere. Consols gained another ⅝, making a rise of 1¼ in the week, with business done at 73. In the Money Market, rates declined freely, and a pretty general expectation was formed of an early reduction in the Bank rate. Business in the Gas Market was on about a moderate average scale, and without any striking feature. The general tendency was quite favourable, and advances were made in the quotations of several of the leading undertakings. In Gaslight and Coke issues, the ordinary was in some demand at firm figures, transactions rising from 101¾ to 102⅝. In the secured issues, the maximum realized 76¾ to 78 (a rise of 1), the preference 95½ to 96 (a rise of 1), and the debenture 72½ and 73. South Metropolitan was higher at 109½ and 111½ (a rise of 1), and the debenture marked 71 and 72. In Commercials, the 4 per cent. fetched 107½, and the 3½ per cent. 103¾ and 104—a rise of ½. Among the Suburban and Provincial group, Brentford old marked 266, Bournemouth preference 13 7/16 and 13⅝, Brighton 203, British 44½, Lea Bridge 118½, South Suburban 116, and Wandsworth "C" 113½. In the Continental companies, Imperial changed hands at 169 and 172 (a rise of 1), ditto debenture 85, Union preference 115, European 17½ *cum div.* to 16⅝ *ex div.*, and Malta 4½. Among the undertakings of the remoter world, Oriental made 120½, Ottoman 7 1/16 and 7¾, Primitiva 5¾ to 6, ditto preference 4¾ to 4 15/16, and San Paulo 11 and 11 1/16.

OFFICIAL QUOTATIONS AT THE CLOSE OF THE WEEK.

Bank Rate (fixed January 8), 4½ per cent. Last year, 5 per cent. Consols, 72⅞—73⅛. Previous week, 71⅝—71⅞.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 15	4	Alliance & Dublin Ord.	56—60	..	6 13 4
374,000	,,	Jan. 15	4	Do. 4 p.c. Deb.	78—81*	..	4 12 9
280,000	5	Oct. 15	7½	Bombay, Ltd.	6—6½	..	5 15 5
50,000	10	Aug. 28	15	Bourne- mouth Gas & Water	10 p.c. . . B 7 p.c. . . Pref. 6 p.c.	..	4 11 10
347,500	10	,,	7		14⅞—15½	..	4 11 10
75,000	10	,,	6		13½—13⅞	..	4 7 3
380,000	Stk.	Aug. 14	14	Brentford Consolidated	262—267	..	5 4 10
330,000	,,	,,	11	Do. New	203—203	..	5 5 9
50,000	,,	,,	5	Do. 5 p.c. Pref.	111—113	..	4 8 6
206,250	,,	Dec. 11	4	Do. 4 p.c. Deb.	91—93	..	4 6 0
217,380	Stk.	Aug. 28	11	Brighton & Hove Orig.	201—206	..	5 6 10
244,200	,,	,,	8	Do. A Ord. Stk.	149—152	..	5 5 3
530,000	20	Sept. 26	12½	British	44½—45½	..	5 9 11
120,000	Stk.	Dec 30	4	Do. 4 p.c. Deb. Stk.	85—87	..	4 12 0
245,771	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	89—91	..	4 7 11
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	2½—4½	..	—
100,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	73—78	..	5 15 5
157,150	Stk.	Aug. 14	5	Chester 5 p.c. Ord.	109—111	..	4 10 1
1,513,280	Stk.	Aug. 28	5¾	Commercial 4 p.c. Stk.	106—108	..	5 1 2
560,000	,,	,,	6¼	Do. 3½ p.c. do.	103—105	+⅛	5 1 6
475,000	,,	Dec. 11	8	Do. 3 p.c. Deb. Stk.	70—72	..	4 3 4
800,000	Stk.	,,	4½	Continental Union, Ltd.	79—82	..	5 9 9
200,000	,,	,,	7	Do. 7 p.c. Pref.	115—120	−2	5 16 8
492,270	Stk.	—	5¾	Derby Con. Stk.	123—125	..	4 12 0
55,000	,,	—	4	Do. Deb. Stk.	102—104	..	3 16 11
1,002,180	10	Jan. 15	10	European, Ltd.	16½—17½*	..	5 14 3
16,386,660	Stk.	Aug. 14	4/17/4	Gas- light and Coke	4 p.c. Ord. . . 3½ p.c. max. . . 4 p.c. Con. Pref. . . 3 p.c. Con. Deb.	..	4 14 7
2,600,000	,,	,,	3½		75—78	+1	4 9 9
4,062,235	,,	,,	4		94—97	+1	4 2 6
4,674,850	,,	Dec. 11	3		71—73	..	4 2 2
258,740	Stk.	Sept. 11	5	Hastings & St. L. 3½ p.c.	88—90	..	5 11 1
70,000	10	Oct. 15	11	Hongkong & China, Ltd.	16⅜—17½	..	6 7 6
131,000	Stk.	Sept. 11	7⅞	Ilford A and C	150—153	..	4 19 8
65,780	,,	,,	6½	Do. B	118—120	..	5 2 1
65,500	,,	Dec. 30	4	Do. 4 p.c. Deb.	87—89	..	4 9 11
4,940,000	Stk.	Nov. 13	9	Imperial Continental	168—173	+1	5 4 0
1,235,000	Stk.	Aug. 14	8½	Do. 3½ p.c. Deb. Red.	83½—85½	..	4 1 10
200,242	Stk.	Aug. 28	6½	Lea Bridge Ord. 5 p.c.	118—121	..	5 3 4
561,000	Stk.	,,	10	Liverpool United A	209—211	−1	4 14 9
718,100	,,	,,	7	Do. B	145—147	..	4 15 3
306,083	,,	Dec. 30	4	Do. Deb. Stk.	93—95	..	4 4 3
63,480	Stk.	Dec. 30	3	Maidstone 3 p.c. Deb.	65—67	..	4 9 7

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
75,000	5	Dec. 11	6	Malta & Mediterranean	4⅜—4⅞	..	6 3 1
250,000	100	Oct. 1	4½	Met. of Melbourne 4½ p.c. Deb.	97—99	..	4 10 11
541,920	20	Nov. 27	4	Monte Video, Ltd.	11⅞—12¼	..	6 10 8
1,775,892	Stk.	July 30	4½	Newc'tle&G'tesh'd Con.	99½—100½	+1	4 9 7
529,705	Stk.	Dec. 30	2½	Do. 3½ p.c. Deb.	82½—83	..	4 4 4
55,940	10	Aug. 28	7/1 9/16	North Middlesex 7 p.c.	12½—13½	..	5 11 5
300 000	Stk.	Nov. 27	8	Oriental, Ltd.	120—125	..	6 8 0
60,000	5	Sept. 26	10	Ottoman, Ltd.	7⅞—8¼	−⅛	6 3 1
60,000	50	Aug. 14	13	Portsea, Island B	130—133	+3	4 17 9
100,000	50	,,	12	Do. C	120—123	..	4 17 7
249,980	5	Oct. 15	8	Primitiva Ord.	5¾—6¼	..	6 8 0
499,960	5	Dec. 30	5	,, 5 p.c. Pref.	4¾—5	..	5 0 0
521,600	100	Dec. 1	4	,, 4 p.c. Deb.	92—94	..	4 5 1
346,198	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	86—88	..	4 10 11
275,000	5	Sept. 26	12	San Paulo, Ltd.	—	..	—
150,000	10	,,	6	Do. 6 p.c. Pref.	10½—11⅞	−⅛	5 5 6
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.	47—49	..	5 2 0
135,000	Stk.	Aug. 28	10	Sheffield A	222—224	..	4 9 8
209,984	,,	,,	10	Do. B	221—223	..	4 9 8
523,500	,,	,,	10	Do. C	220—222	..	4 10 1
90,000	10	Oct. 15	7½	South African	9½—10½	..	7 2 10
6,429,895	Stk.	Aug. 14	5/9/4	South Met., 4 p.c. Ord.	109½—111½	+1	4 18 0
1,895,445	,,	Jan. 15	3	Do. 3 p.c. Deb.	71½—73½*	+1	4 1 8
209,820	Stk.	Aug. 14	8½	South Shields Con. Stk.	157—159	..	5 6 11
952,795	Stk.	,,	6	S'th Suburb'n Ord. 5 p.c.	115—117	..	5 2 7
60,000	,,	,,	5	Do. 5 p.c. Pref.	112—114	..	4 7 9
117,058	,,	Dec. 30	5	Do. 5 p.c. Deb. Stk.	113—115	..	4 6 11
594,740	Stk.	Nov. 13	5	Southampton Ord.	100—103	..	4 17 1
120,000	Stk.	Aug. 14	7⅜	Tottenham A 5 p.c. . . B 3½ p.c. . . 4 p.c. Deb.	137—140	..	5 5 4
543,940	,,	,,	5⅝		115—117	..	5 0 5
149,470	,,	Dec. 30	4		88—90	..	4 8 11
182,380	10	,,	5	Tuscan, Ltd.	5—6	..	8 6 8
149,900	10	Jan. 2	6	Do. 5 p.c. Deb. Red.	95—97	..	5 3 1
236,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.	111—113	..	4 8 6
30,000	Stk.	Aug. 28	8⅜	Wandsworth, Wimbledon, and Epsom— Wandsworth A 5 p.c.	155—160	..	5 4 8
255,636	,,	,,	6⅞	,, B 3½ p.c.	130—135	..	5 1 10
108,075	,,	,,	5/17/3	,, C 3½ p.c.	110—115	..	5 2 0
352,000	,,	,,	6½	Wimbledon 5 p.c.	111—116	..	5 5 7
98,000	,,	,,	6⅜	Epsom 5 p.c.	115—120	..	5 10 5
88,416	,,	Dec. 30	3	3 p.c. Deb. Stk.	66½—68½	..	4 7 7

Prices marked * are "Ex. Div."

The Maine Lighting Company, Limited, has been registered with a capital of £2000, in £1 shares, to take over the business carried on by T. Haworth and H. Shepherd at Burnley, as the Maine Lighting Company, and as lighting and heating engineers, &c.

The representatives of the Parkinson Stove Company held their annual conference last Tuesday, at the Imperial Hotel, Birmingham. Mr. William Cheshire (Director) presided, and was supported by Mr. Percy C. Mawbey, the General Manager. Arrangements were also made for viewing the works now in course of erection at Stechford. The conference was followed by a dinner, concluding with a musical evening.

The fusing of a wire at the Clyde Valley Electrical Works, Yoker, recently cut off the current from a large portion of Clydebank for over a quarter-of-an-hour. About 2000 children were witnessing an entertainment in the Town Hall, when the light was suddenly extinguished. Fortunately a panic was averted—probably in consequence of the prompt and successful efforts of the orchestra to secure the attention of the little ones.

The report of the District Auditor (Mr. John Orchard) on the accounts of the Hastings Corporation for the twelve months to March 31 last states that for the electricity undertaking a net profit of £545 is shown on the working of the year. The average price per unit obtained from sales to private consumers was 5·21d., and the amount charged to public lighting averaged 4·24d. per unit. The cost per unit sold was 2·16d., excluding loan charges, and 5d. per unit including loan charges. "If the actual cost per unit, including loan charges, of the current used for public lighting had been charged to the district fund, the net profit would have been about £1600."

An inquiry was held at the St. Pancras Coroner's Court on Saturday, by Mr. Walter Schroeder, relative to the death of Frank Bessant (53), a gasfitter in the employ of the Gaslight and Coke Company at their yard in Camden Road. Mr. Norman H. Mathews (Messrs. Monier-Williams, Robinson, and Milroy) attended on behalf of the Company. It appeared from the evidence that the deceased was subject to epileptic fits, and that on the 12th of December he fell on the bars of a meter and struck his jaw. The meter turned over, and deceased fell on to the pavement of the yard. He was removed in an unconscious condition to the West Hampstead Hospital, where he was found to be suffering from a fracture of the lower jaw. Next day the deceased told the House Surgeon (Mr. Herbert O'Callaghan) that he had had a fit. The second day after his admission it was found that he was suffering from bronchitis, which became septic, and he had all the symptoms of gangrene of the lungs. This was stated by the House Surgeon to have been the cause of death; and the Jury returned a verdict in accordance with his evidence—adding that there was nothing but the epileptic fit to cause the fall.

At the Harrogate Borough Court last Tuesday, two errand boys, aged fifteen and fourteen respectively, were charged with stealing money from prepayment gas-meters. There were eight or nine cases against them, but only two were proceeded with. Both boys had been before the Court on two previous occasions for other offences. The Mayor (Alderman J. Sheffield) said the boys had got into a bad way; and were living under evil influences. The Bench considered they would be doing them a great kindness by sending them to a reformatory until they were nineteen years of age.

APPLICATIONS FOR LETTERS PATENT.

250.—Harger, J., "Estimating substances in gases." Jan. 5.
264.—Schwarz, P., "Extraction of tar." Jan. 5.
274.—Linley and Co., Owensmith, W. H., and Edwards, J., "Acetylene generator." Jan. 5.
283.—Meyer-Keller, O., "Lighting and extinguishing gas-lamps." Jan. 5.
303.—Dellwik-Fleischer Wassergas, G.m.b.H., "Production of producer gas." Jan. 5.
304.—Dellwik-Fleischer Wassergas, G.m b.H., "Production of water gas." Jan. 5.
349.—Zink, R. J., "Treating tar oils." Jan. 6.
415 —Horstmann, E. H., G. O. H., A., & S. A., and Edgar, W. T., "Gas-controllers." Jan. 7.
427.—Brooker, H. T. & H., "Distance gas-lighting." Jan. 7.
467.—Prestage, E., "Gas-compressors." Jan. 7.
476.—International Nitrogen and Power Company, Ltd., and Lucas, O. D., "Gas-producers." Jan. 7.
511.—Imray, O., "Meters for liquids." A communication from A. B. Buckley. Jan. 8.
523.—British Graetzin, Ltd., and Grafton, W., "Nozzles for gas-burners." Jan. 8.
550.—Feeny, V. I., "Gas-cocks." Jan. 8.
623.—Knowles, J. C., "Box simmerer to gas cooking-stove." Jan. 9.
627.—Burdick, C. L., "Recording consumption of gas, together with its value." Jan. 9.
635.—Joseph, R., "Gas-saving kettle." Jan. 9.
691.—Liversedge, A. J.. and Davidson, W. B., "Gas-washing apparatus." Jan. 10.
705.—Fletcher, Russell, and Co., Ltd., and Fletcher, T. W., "Cocks or valves for gas-burners." Jan. 10.
706.—Fletcher, Russell, and Co., Ltd., and Fletcher, T. W., "Water-heaters." Jan. 10.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

Engineer and Manager. British Gaslight Company (Potteries). Applications by Feb. 3.
Gas Engineer and Manager. Swinton and Mexborough Gas Board. Applications by Feb. 9.
Representative. No. 5835.
Assistant Outdoor Superintendent. No. 5830.
Chemist and Works Assistant. No. 5830.
Working Manager. Tetbury Gas Company.
Main and Service Layer. No. 5837.

Appointments, &c., Wanted.

Secretarial or Commercial Department. No. 5838.

Gas-Works Wanted.

"D. G.," Scripps's Advertising Offices, 13, South Molton Street, W.

Plants, &c. (Second-Hand), for Sale.

Blowing Plant. Scarborough Gas-Works.
Kern Burners. No. 5836.

Plant, &c. (Second-Hand), Wanted.

Purifiers. No. 5833.
Water-Gas Plant. No. 5834.

Meetings.

Barnstable Gas Company, Bridge Hall, Barnstaple. Feb. 14. Twelve o'clock.
South Metropolitan Gas Company, De Keyser's Hotel. Feb. 11. Two o'clock.
South Suburban Gas Company. De Keyser's Hotel. Feb. 13. Three o'clock.

Patent Licences.

Fixing Mantles. Tilley High Pressure Gas Syndicate, Kingsland Road.
Incandescent Lamps for Vaporized Liquids. Haseltine, Lake, and Co., Southampton Buildings, Chancery Lane, E.C.

Sales of Stocks and Shares.

East Grinstead Gas and Water Company. London Mart. Feb. 3.

TENDERS FOR

Cookers.

Pontypridd Gas Department. Tenders by Feb. 9.

Fire-Clay Goods.

Pontypridd Gas Department. Tenders by Feb. 9.

General Stores (Lime, Sulphuric Acid, Lead and Compo Tubing, Barrow, Rake Heads, Cocks and Taps, Oils and Benzol, Copper, &c.).

Pontypridd Gas Department. Tenders by Feb. 9.
Salford Gas Department.

Incandescent Materials, Lamps, and Fittings.

Pontypridd Gas Department. Tenders by Feb. 9.

Meters.

Pontypridd Gas Department. Tenders by Feb. 9.

Pipes, &c.

Pontypridd Gas Department. Tenders by Feb. 9.

Scrubber-Washer and Tar-Extractor.

Forfar Gas Corporation. Tenders by Feb. 10.

Tar and Liquor.

Birmingham Public Works Committee. Tenders by Feb. 28.
Pontypridd Gas Department. Tenders by Feb. 9.

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Subscribers who desire to avail themselves of the reduction in the Subscription by paying in advance for the Year 1914 are reminded that this can only be done during the current month.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

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Candidates must not be less than 27 Years of Age, and be thoroughly trained Works and Distributing Engineers.
The person appointed will be required to devote the whole of his time to the duties of the office, and reside within the district of supply.
The Salary will be £200 per Year.
Applications, stating Experience and accompanied by *copies* of not more than Three recent Testimonials, endorsed "Gas Engineer," must be Addressed to J. W. Hattersley, Esq., Clerk to the Gas Board, Mexborough near Rotherham, not later than Feb. 9. 1914.
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Jan. 17, 1914.

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